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**FINAL DESIGN REPORT
OPERABLE UNIT NO. 2 (OU-2)
216 PATERSON PLANK ROAD SITE
CARLSTADT, BERGEN COUNTY, NEW JERSEY**

Prepared for:

216 Paterson Plank Road Cooperating PRP Group

Prepared by:

Golder Associates Inc.
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Project No.: 943-6222

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May 8, 2007

Proj. No.:943-6222

Ms. Stephanie Vaughn
United States Environmental Protection Agency
290 Broadway
New York, New York 10007-1866

**RE: FINAL (100%) DESIGN REPORT
216 PATERSON PLANK ROAD SITE – OPERABLE UNIT NO. 2 (OU-2)
CARLSTADT, BERGEN COUNTY, NEW JERSEY**

Dear Ms. Vaughn:

On behalf of the 216 Paterson Plank Road Cooperating PRP Group (Group), please find enclosed three (3) copies of the Final (100%) Design Report (FDR) for Operable Unit No. 2 (OU-2) at the subject Site.

In accordance with the Consent Decree entered between USEPA and the Group that was effective September 30, 2004, this FDR is the third design deliverable for the subject project, and was prepared in accordance with the approved Remedial Design Work Plan (RDWP), dated April 1, 2005. The FDR includes the Minor Stream Encroachment Permit Equivalency associated with remedial work proximate to Peach Island Creek.

As requested, three (3) copies of this FDR have also been transmitted directly to the New Jersey Department of Environmental Protection (NJDEP), and three (3) copies have been sent to the U.S. Army Corps of Engineers.

In addition to this FDR, Golder has prepared responses to the Agency comments on the Pre-Final (95%) Design Report (PFDR), dated October 30, 2006. These responses are attached and include descriptions of how the comments have been addressed in the FDR. Preliminary responses were discussed during a conference call on April 6, 2007. Following that conference call, Golder submitted additional information regarding the EPA's comments on April 16, 2007 and further clarification was received via e-mail from the EPA on April 20, 2007.

If you have any questions or require additional information during the course of your review of these documents, please feel free to contact the undersigned at (856) 793-2005.

Very Truly Yours,

GOLDER ASSOCIATES INC.

P. Stephen Finn, C. Eng.
Project Coordinator

cc: Riché Outlaw, NJDEP
Robert Boucher, USACOE
216 Paterson Plank Road Technical and Executive Committees
William L. Warren, Esq.

**216 PATERSON PLANK ROAD SITE – OPERABLE UNIT NO. 2 (OU-2)
CARLSTADT, BERGEN COUNTY, NEW JERSEY**

**RESPONSE TO AGENCY COMMENTS ON THE
PRE-FINAL (95%) DESIGN REPORT**

On behalf of the 216 Paterson Plank Road Cooperating PRP Group (Group), Golder Associates Inc. (Golder) has prepared the following responses to USEPA's comments on the Pre-Final (95%) Design Report based on our recent discussions and correspondence. Agency comments are numbered and re-printed herein in ***Bold Italics*** with corresponding responses directly following each comment.

Comment 1: Section 3.2 Page 12

Please provide additional detail related to the horizontal and vertical extent of the VOC and PCB concentrations in the hot spot area, as well as the concentrations. We are not asking for a full reproduction of the data, just a more detailed summary.

The aerial and vertical extent of the VOC and PCB contamination is detailed in Figure 8 of the Final Design Report (FDR), entitled "in-situ 'hot spot' treatment plan and details". Tables from the Focused Feasibility Study Investigation Report (Golder 1997) which indicate the depth of samples and concentrations found in the boreholes shown in Figure 8 are included in the FDR.

Comment 2: Section 3.4.2, pages 14 to 22

All soil, fill and drainage materials brought to or used at the site for construction of the cap should be analyzed for inorganic chemicals (particularly calcium, sulfate, carbonate, sodium, chloride, potassium, etc.) and their leaching properties, so that unacceptable levels of inorganic chemicals will not enter the runoff or infiltrated water. The fill material should not include shells.

As discussed with the EPA, the specification for imported soil material will be revised to specifically include shells as a deleterious material that must not be included for the soil to be acceptable for use during construction. The imported soils will be visually inspected by the independent quality assurance official to ensure that there are no shells.

In addition, the EPA has requested testing of the fill material above the geomembrane to ensure it does not adversely affect the pH of the surface water. Therefore, Golder has added a requirement to the imported soil material Specifications (i.e. cover soil and topsoil) which requires that a Synthetic Precipitation Leaching Procedure (SPLP) test be run on the fill material. The SPLP will be run using a solution with pH of 4.5, as this is the average pH of rainwater in the region. The pH of the resulting leachate will be tested to verify that the pH is within the range of 4.5 to 8.5. The upper limit of the range is based on the NJDEP Surface Water Quality Limit for FW-2 waters.

Comment 3: Section 3.4.2.6, page 21

The response provided to EPA comment Number 4 on the 35% design (related to the HELP model) should be incorporated into the final design report.

The response to USEPA comment No. 4 on the 35% Design Report explaining how the 99% reduction in recharge rate was established has been included in the text of the FDR.

Comment 4: Section 3.6.2, Pages 29 to 31

The report should state the performance criteria that will be utilized, as per EPA Comment Number 8 on the 35% Design.

Comment Number 8 from the EPA on the 35% Design Report was a statement regarding the performance criteria used for In-Situ Solidification/Stabilization (ISS) work carried out at a site in Elizabeth, NJ. The performance criteria are based on site specific conditions and requirements and therefore the specific criteria used at the Elizabeth site are not directly applicable to the 216 Paterson Plank Road site.

The performance criteria for the "hot spot" treatment was determined for the 216 Paterson Plank Road site based on the previous feasibility studies and the performance criteria set forth in the ROD. Performance criteria and quality control testing requirements that satisfy the ROD requirements are detailed in the Technical Specification for the hot spot treatment (Technical Specification – 02450). The Technical Specification includes requirements for quality control testing comparable to the Elizabeth site, such as post-ISS head-space testing, post ISS- strength testing, post-ISS leachability testing, and visual observation of mixing efficiency.

The text of the FDR has been updated to further summarize specific performance criteria outlined in the ROD and detailed in the Technical Specification, including: the average VOC levels of treated mass shall be equal to or less than 1,280ppm; the average leachability of the treated mass shall be reduced by 90% as compared to the FFS results; and the average 28-day strength of the treated mass shall be at least 15 psi.

Comment 5: Section 3.7, Pages 35 to 40

EPA still believes that some interior pumping will be useful. If the wells prove not to be useful in the future they could be decommissioned.

The ROD specifically indicates that the improved groundwater extraction system will consist of wells along the *perimeter* of the site. As requested, Golder has further evaluated the potential need for wells on the interior of the site. In particular we note the following:

- Results of design calculations and modeling presented in the 95% Design Report indicate that no interior groundwater wells are needed to achieve hydraulic control and containment of the shallow groundwater. The model indicates that little to no groundwater mounding across the central portion of the site is expected to occur, due to the fact that the cap will virtually eliminate infiltration.
- As noted in the response to the 35% Design Report, the new cap design will be much more efficient than the current system at limiting direct infiltration recharge of groundwater on the site. Even under the current temporary cover conditions, groundwater level data taken over many years has shown that when the system was off for a significant period of time, there was no significant rise in on site groundwater levels. This is illustrated by hydrographs, including those for piezometers located in the site interior (for example, P-2, P-3, and P-4), previously provided to EPA.
- Water balance calculations presented in the 95% Design Report also indicate that the new system will be capable of achieving the design criteria in the interior Fill stratum.

However, based on further discussion with EPA, two interior wells/piezometers have been added to the FDR in order to confirm that water levels in center of the site remain under control.

Comment 6: Page 36, Section 3.7.1

In the enhanced groundwater recovery system overview, revise the text to specify how extraction wells will be installed.

The text of this section has been revised to reference the Technical Specifications and summarize installation requirements. Details of the well construction and installation requirements are provided in Technical Specification 02675 entitled "Well Construction". This specification indicates that all well installation activities will be performed in accordance with the procedures defined in N.J.A.C. 7:9. Final drilling methods will be based on the Contractor recommendation, subject to approval by the Remedial Designer. Use of mud rotary drilling techniques is not recommended, as excessive amounts of mud may be needed. The Specification includes a requirement that a list of all equipment to be used for well installation, including proposed drill rigs and torque capacity, be provided by the Contractor.

Comment 7: Figure 9

Additional wells between the slurry wall and the new sheet pile wall could still be useful for monitoring to prove that the remedy is working over time.

As described in the Remedial Design Work Plan (November 2004), the goal of the groundwater extraction system is to maintain inward gradients across the slurry wall, except along Peach Island Creek where it is not possible to maintain inward groundwater gradients. Wells installed in the extremely narrow area between the slurry wall and sheet pile wall would merely indicate the level of the Creek, which would more easily be obtained via a staff gauge.

Based on further discussion with EPA, a staff gauge will be installed in the Creek adjacent to the site to collect water levels within the Creek. Data loggers will be installed for baseline monitoring in the proposed piezometers on the Creek side of the site and on the staff gauge. Baseline monitoring will be completed after the cap is in place to see how the site water levels fluctuate tidally. It is expected that there will be some fluctuation, which will be muted and lagging from the stream. Subsequent monitoring will be timed relative to tidal cycles in order to determine if there is any unexpected change in water levels that might indicate a leak in the system. In addition, surface water samples will continue to be taken as part of the O&M to verify there is no negative impact on Peach Island Creek from the site. These monitoring requirements will be detailed in the O&M Plan.

Comment 8: Figures / Drawings

The drawings are not at a level of detail suitable for construction. The primary component missing is the survey control necessary for placement of the various landfill ad other project features.

An additional figure entitled Survey Control has been added to the FDR, indicating survey control points and their coordinates. In general, the drawings were prepared primarily for bidding purposes. Specific locations of design elements such as the well locations and line placements will be determined in the field by the contractor based on site conditions. As outlined in the Field Engineering and Surveying Technical Specification, the contractor will be responsible for establishing control points, which are tied to vertical and horizontal references for the site, and for layout of the work during the implementation and providing final as built drawings relative to those control points. Golder will independently verify the contours and grading of the implemented remedy relative to the design for quality control purposes.

Comment 9: Specification Section 02224, Paragraph 3.02.C

The directions for placement of the sample in the direct shear mold are somewhat vague. It appears this may result in inconsistent or non-representative results.

There is no paragraph 3.02C for Specification Section 02224. It is understood that this was intended to be a comment related to Paragraph 2.02C of the referenced section.

Specification Section 02224 has been revised in the FDR and provides that the Contractor will be required to develop a compaction method to meet a target level for density and moisture content. The Contractor will be required to demonstrate that direct shear tests on specimens prepared to the same density and moisture content exhibit a minimum internal friction angle of twenty-five degrees.

Comment 10: Specification Section 02224, Paragraph 3.02.D

This paragraph specifies a minimum hydraulic conductivity of 1×10^{-4} cm/s for the cover soil. The reviewer was not able to find the purpose of this anywhere in the design report. The purpose should be included in the report.

There is no paragraph 3.02D for Specification Section 02224. It is understood that this was intended to be a comment related to Paragraph 2.02D of the referenced section. Specification Section 02224 has been modified to: a) further clarify the required soil cover gradation and direct shear testing requirements; and, b) to remove the hydraulic conductivity requirement, which was previously specified under Section 02224-2.02-D.

In general, cover soil materials should be relatively "free" draining and the hydraulic conductivity testing was included as a way to measure the soils drainage characteristics. The Final Design Report removes the testing requirement for hydraulic conductivity and the gradation requirements for the cover soil have been slightly modified to ensure that "free" draining materials are utilized while not significantly limiting the contractors ability to identify acceptable borrow source materials. Gradation testing will be conducted to confirm that "free" draining soils are used for the cover soil.

Comment 11: General

Please verify that all of the information listed in Section VII, Paragraph C of the Statement of Work related to the design is included. Please include any items that have not yet been incorporated into the design in the Final Design Report.

Section VII, Paragraph C of the Statement of Work was reviewed to ensure all items related to the design have been completed. Additional items identified that have been included in the FDR comprise:

- A list of property owners of record within 200 ft of site, all easements, rights-of-way, and reservations.
- A specification for a warning sign at the site.
- A general description of the method of selection that will be used to retain the construction contractor(s).

Information regarding existing utilities ,decontamination areas, staging areas, borrow areas and stockpiling areas will be identified by the selected contractor, as needed, and included in submittal reviews undertaken by the Remedial Designer.

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LIST OF ACRONYMS

ACGIH	American Conference for Governmental Industrial Hygienists
ARAR's	Applicable and Relevant and Appropriate Requirements
ASGECI	Amy S. Greene Environmental Consultants Inc.
ASTM	American Society of Testing and Materials
bgs	Below Ground surface
BRA	Baseline Risk Assessment
CCC	Chemical Control Corporation
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CQAP	Quality Control Assurance Plan
CY	Cubic Yards
DET	Dupont Environmental Treatment
DM	Design Manual
DOT	Department of Transportation
DQO's	Data Quality Objectives
ERM	Environmental Resource Management
FFS	Focused Feasibility Study
FFSI	Focused Feasibility Study Investigation
FIRM	Flood Insurance Rate Maps
FIS	Flood Insurance Study
FS	Feasibility Study
GCL	Geosynthetic Clay Liner
GM	Geomembranes
Group	216 Paterson Plank Road Cooperating PRP Group
HAS	Hallow Stem Auger
HASP	Health and Safety Plan
HDPE	High Density Polyethylene
HELP	Hydrologic Evaluation of Landfill Performance
ISAS	In-Situ Air Stripping
ISS	In-Situ Soil Stabilization
LHT	Leachate Holding Tank
LS	Linear Feet
MDL	Method Detection Limit
NAAQS	National Ambient Air Quality Standards
NAD	North American Datum
NAVD	North American Vertical Datum
NAVD 88	North American Vertical Datum of 1988
ND	Not Detected
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NGVD	National Geodetic Vertical Datum
NGVD 29	National Geodetic Vertical Datum of 1929
NIOSH	National Institute for Occupational Safety and Health
NJDEP	New Jersey Department of Environmental Protection Agency
NPL	National Priorities List
NT	Not Tested
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
OU-1	Operable Unit No. 1

LIST OF ACRONYMS

OU-2	Operable Unit No. 2
OU-3	Operable Unit No. 3
PAH's	Polynuclear Aromatic Hydrocarbons
PCB's	Polychlorinated Biphenyls
PDI	Pre-Design Investigation
PDR	Preliminary design Report
PFDR	Pre-Final Design Report
PID	Photo-Ionization Detector
POP	Project Operations Plan
POTW	Publicly Owned Treatment Works
ppm	Parts Per Million
PRP	Potential Responsible Party
psf	Pounds-per-square-foot
psi	Pounds-per-square-inch
QA	Quality Assurance
QAO	Quality Assurance Official/Offices
QC	Quality Control
RCRC	Resource Conservation and Recovery Act
RDWP	Remedial Design Work Plan
RI	Remedial Investigation
ROD	Record of Decision
SF	Square Foot
Site	216 Paterson Plank Road Site
SPLP	Synthetic Precipitation Leachate Procedure
SPT	Standard Penetration Test
SSP	Sediment Survey Points
SVOC	Semi-Volatile Organic Compounds
TAL	Target Analytical List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leachate Procedure
UCS	Unconfined Compressive Strength
USACOE	United States Army Corp of Engineers
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USLE	Universal Soil Loss Equation
VLF	Vertical Linear Feet
VOC	Volatile Organic Compound

1.0 INTRODUCTION

1.1 General

On behalf of the 216 Paterson Plank Road Cooperating PRP Group (Group), Golder Associates Inc. (Golder) has prepared this Final Design Report (FDR) for the Second Operable Unit (OU-2) Remedy at the 216 Paterson Plank Road Site (Site) located in Carlstadt, Bergen County, New Jersey (see Figure 1).

On August 26, 2002, the United States Environmental Protection Agency (USEPA) issued a Record of Decision (ROD) (USEPA, 1993) for OU-2, which identified the selected remedy for the fill and shallow groundwater above the clay layer underlying the Site. Subsequently, a Consent Decree was lodged on July 14, 2004, with an effective date of September 30, 2004, which provides for implementation of the OU-2 final remedial design/remedial action by the Group.

Pursuant to the Consent Decree, this FDR is the third of three (3) design deliverables for the OU-2 Remedy, and was prepared in accordance with the revised Remedial Design Work Plan (RDWP) for OU-2, USEPA's approval of which was received on June 9, 2005. Furthermore, this FDR supercedes the previously prepared Pre-Final (95%) Design Report (PFDR) for the OU-2 Remedy, which was issued to USEPA on October 30, 2006 and addresses EPA comments on the PFDR, as received on March 1, 2007, and further clarified in correspondence from EPA received on April 20, 2007.

1.2 Site Background

The Site is located at the intersection of Paterson Plank Road and Gotham Parkway in Carlstadt, Bergen County, New Jersey, and covers an area of about 6-acres (see Figures 1 and 2).

A chemical recycling and waste processing facility, which ceased operation in 1980, formerly occupied the Site. In 1983, the Site was placed on USEPA's National Priorities List (NPL). The Site is bordered to the southwest by Paterson Plank Road, to the northwest by Gotham Parkway, to the southeast by a trucking company, and to the northeast by Peach Island Creek.

1.2.1 Previous Studies

In 1987, a Remedial Investigation (RI) (Dames and Moore, 1990) was initiated, which evaluated soil and groundwater conditions beneath the Site. For this RI, thirty (30) borings were drilled across the Site, and chemical analyses were performed on soil samples collected from seventeen (17) of these borings. In broad terms, this RI revealed ground conditions comprising fill overlying a clay layer, which was in turn underlain by glacial till and bedrock.

The original RI also included the installation of fourteen (14) shallow piezometers (P-1 thru P-14) and seven (7) shallow monitoring wells (MW-1S thru MW-7S), which were installed within the uppermost fill stratum. In addition, three (3) deeper monitoring wells (MW-2D, MW-5D and MW-7D) were installed, screened within the underlying glacial till stratum.

In 1989, Environmental Resource Management, Inc. (ERM) conducted an initial Feasibility Study (FS) (ERM, 1989), and this FS evaluated remedial alternatives for the designated First Operable Unit (OU-1) comprising groundwater and soils/sludge above the clay layer.

In 1989, nine (9) additional monitoring wells were installed off-property by Dames and Moore, pursuant to Project Operations Plan (POP) No. 8 (Dames and Moore, 1988). Of these wells, five (5) were shallow monitoring wells screened within the fill (MW-8S thru MW-12S) and four (4) were deeper monitoring wells (MW-8D, MW-11D, MW-12D, and MW-13D). In addition, one (1) bedrock well (MW-2R) was installed on-site by Dames and Moore in 1989, pursuant to POP No. 9 (Dames and Moore, 1988).

In July 1989, Dames and Moore also excavated twenty-three (23) test pits to further evaluate the nature of the uppermost fill materials, and the results of these test pits were summarized in a report titled Final Report - Excavation of Test Pits (Dames and Moore, 1989).

In 1990, a Baseline Risk Assessment (BRA) of the Site was conducted by Clement Associates (Clement, 1990) for the USEPA, following USEPA guidance for conducting risk assessments current at the time and utilizing information primarily collected during the initial phase of the RI.

Subsequently, USEPA selected an Interim Remedy (OU-1 Remedy) in 1990 (see Section 1.2.2).

Following implementation of the OU-1 Remedy and at the request of USEPA, a Focused Feasibility Study (FFS) was conducted to evaluate final remedial actions for the contaminants known to reside within the fill material and shallow groundwater (Golder, 2001).

The FFS included an additional field investigation program comprised of a geophysical survey, soil borings, and laboratory testing to delineate a distinct sludge "Hot Spot" area, and the results of this investigation were presented in a Focused Feasibility Study Investigation (FFSI) Report (Golder, 1997). The FFS also included a laboratory treatability study (Kiber, 2000) to evaluate options for in-situ treatment/stabilization of the sludge materials.

In 2001, the FFS was finalized and submitted to USEPA, leading to USEPA's selection of a remedy for the fill materials and shallow groundwater, referred to as Operable Unit 2 (OU-2), in August 2002.

1.2.2 Interim Remedy

As noted above, USEPA issued a ROD, dated September 14, 1990, selecting an Interim Remedy (OU-1 Remedy) based on the original RI, FS, and the BRA. This ROD defined OU-1 as "contaminated soils and groundwater above the clay layer", and the selected remedy comprised the following major elements:

- Installation of a slurry wall around the entire Site;
- Installation of an infiltration barrier over the Site;
- Installation of a groundwater collection system, and extraction of groundwater from the designated OU-1 zone; and
- Off-site treatment and disposal of extracted groundwater.

USEPA determined the selected OU-1 Remedy would "reduce the migration of hazardous substances, pollutants and contaminants out of the first operable unit zone" and be "consistent with an overall remedy which will attain the statutory requirement for protectiveness."

The OU-1 Remedy was designed and implemented by the Group pursuant to an Administrative Order (Index No. II CERCLA - 00116) dated September 28, 1990, and consisted of the following:

-
- a) A lateral containment wall comprising a soil-bentonite slurry wall with an integral high-density polyethylene (HDPE) vertical membrane, which circumscribes the property;
 - b) A horizontal "infiltration barrier" consisting of high density polyethylene (HDPE) covering the property;
 - c) A sheet pile retaining wall along Peach Island Creek;
 - d) An extraction system for shallow groundwater consisting of five extraction wells screened in the fill, which discharge to an above grade ten-thousand (10,000) gallon holding tank via an above grade header system; and
 - e) A chain link fence circumscribing the Site.

The design for the OU-1 Remedy was presented in the Interim Remedy Remedial Design Report (Canonie, 1991), and construction was undertaken between August 1991 and June 1992.

As part of the OU-1 Remedy, eighteen (18) soil borings were conducted to evaluate subsurface conditions in the vicinity of the proposed slurry wall. Upon completion of the OU-1 Remedy, the associated construction activities were documented in the Final Report - Interim Remedy for First Operable Unit (Canonie, 1992).

The OU-1 Remedy has been in operation since June 1992 and extracted groundwater is regularly shipped, via tanker trucks, to the DuPont Environmental Treatment (DET) facility, located in Deepwater, New Jersey, for treatment and disposal. Landscaping along the perimeter of the Site adjacent to Paterson Plank Road and Gotham Parkway was added following installation of the Interim Remedy.

Maintenance and monitoring of the OU-1 Remedy continues to be conducted pursuant to the USEPA approved Operations and Maintenance (O&M) Plan (Canonie, 1991) and subsequent addenda approved by USEPA. The current O&M sampling program includes sampling of four (4) surface water points (SW-01 thru SW-04) quarterly for Target Compound List (TCL) and volatile organic compounds (VOCs), and annually for TCL pesticides/PCBs and Target Analyte List (TAL) metals.

In addition, the current O&M Plan calls for groundwater sampling performed annually for four (4) off-property fill zone monitoring wells (MW-8S, MW-9S, MW-11S, and MW-12S) and four (4) off-property glacial till monitoring wells (RMW-8D, RMW-11D, RMW-12D, and RMW-13D) for full TCL and TAL parameters (see Figure 3 for sampling locations).

1.3 Consent Decree Objectives for OU-2

On August 26, 2002, USEPA issued a ROD for OU-2, which identified the selected remedy for the fill materials and shallow groundwater above the clay layer underlying the Site. Subsequently, a Consent Decree was lodged on July 14, 2004, with an effective date of September 30, 2004, which provides for implementation of the OU-2 final remedial action by the Group.

Per the August 26, 2002 ROD, the remedial action objectives for OU-2 are as follows:

- Mitigate direct contact risks and leaching of contaminants from the shallow fill and sludge material into groundwater;
- Reduce toxicity and mobility of the sludge “Hot Spot” contaminants via treatment;
- Provide hydraulic control of the shallow aquifer by maintaining inward groundwater gradients; and
- Perform remediation such that the remedy may allow for possible, limited (i.e., light commercial) Site re-uses.

The specific remedy elements that were selected in the ROD to achieve these objectives were:

- Installing a new cover system over the entire fill area circumscribed by the existing slurry wall, as shown in Figure 3;
- Undertaking stream bank enhancements to provide improved stability, while avoiding adverse impacts to the existing slurry wall and Peach Island Creek;
- Remediating the sludge “Hot Spot” area by in-situ treatment; and
- Upgrading, enhancing and replacing, as necessary, the existing groundwater recovery system to ensure inward groundwater gradients are maintained.

Furthermore, the objectives of the proposed OU-2 remedial design, consistent with these overall objectives and as required by the approved RDWP and the Statement of Work (see Appendix D to the Consent Decree), the OU-2 Remedial Design process is required to:

- Identify any data gaps that must be fulfilled to complete the Remedial Design for OU-2;
- Describe the Remedial Design tasks and present an approach for the completion of the Remedial Design;

- Describe any approvals and institutional controls which will be needed to comply with the Consent Decree; and
- Provide a schedule for the Remedial Design activities and a draft schedule for remedial action, O&M and monitoring.

2.0 PRE-DESIGN INVESTIGATIONS

2.1 Overview

As noted above, the subsurface conditions beneath the Site have already been substantially investigated, but per the approved RDWP (Golder, 2005), a Pre-Design Investigation (PDI) program was undertaken to fill identified data gaps, so as to allow the OU-2 Remedial Design to be completed. The objectives of this PDI program were to:

- Further examine subsurface conditions between the existing slurry and sheet pile walls to design the proposed streambank enhancements;
- Establish approximate sediment “mud-line” and “firm-bottom” depths/elevations (as defined in Section 2.3 herein), within Peach Island Creek, along the face of the existing sheet pile wall;
- Undertake a laboratory testing program to establish geotechnical engineering design parameters;
- Obtain an updated topographic “base map” survey of the Site and adjacent areas; and
- Perform a wetlands delineation to determine whether any wetlands will be affected by the OU-2 Remedy.

The scope of these PDI investigations did not include the identification and/or delineation of any potential off-Site areas of contamination within Peach Island Creek or the underlying deep (i.e., beneath the shallow Fill stratum) groundwater aquifers, as these areas are being addressed as part of other Operable Units.

2.2 Subsurface Investigation

Consistent with the approved RDWP, five (5) soil borings (RD-1 thru RD-5) were drilled, between the existing slurry and steel sheet pile walls, and these borings were terminated within the underlying Glacial Till stratum. Drilled depths varied from thirty-four (34) to forty-five (45) feet below ground surface (bgs), and averaged about forty (40) feet bgs. Boring locations are shown in Figure 3, and logs are presented in Appendix A.

Drilling activities were performed by AmeriDrill, Inc. of Levittown, Pennsylvania, and the fieldwork for this subsurface investigation program was completed between September 13, 2005 and September 19, 2005.

This PDI field investigation program included the following elements:

- All borings were advanced with a Cantera CT-250 truck-mounted drill rig, utilizing 3.25-inch-diameter hollow-stem auger (HSA) drilling techniques;
- At each location, the driller augered through the existing fill materials to about six (6) feet bgs, and “disturbed” soil samples were collected continuously from six (6) to thirty (30) feet bgs, and at 5-foot intervals thereafter. All borings were terminated within the underlying Glacial Till stratum;
- Drill cuttings and collected “disturbed” soil samples were scanned utilizing a Mini-Rae Photo-ionization detector (PID) to determine the degree, if any, of volatile organic compounds (VOC) within the soil samples, and the associated PID readings were recorded on the field boring logs;
- Standard Penetration Tests (SPT) were performed utilizing 2-inch-diameter “split spoon” samplers, following the American Society for Testing and Materials (ASTM) D1586 procedures. The associated sample recoveries and SPT “N-values” were recorded on the field boring logs;
- “Undisturbed” soil samples were collected within selected soft, compressible deposits utilizing 3-inch-diameter “thin-walled” Shelby Tube samplers. A total of seventeen (17) Shelby Tube samples were attempted, and the ends of these tubes were capped and sealed with wax to maintain field moisture contents. The associated sample recoveries were recorded on the field boring logs;
- All collected soil samples were visually classified in the field in accordance with the Unified Soil Classification System (USCS), and appropriate soil descriptions were noted on the field boring logs. In addition, representative soil samples were preserved for geotechnical laboratory testing;
- Upon completion of drilling activities, each borehole was backfilled, in accordance with New Jersey Department of Environmental Protection (NJDEP) requirements;
- All drill cuttings and fluids generated by the drilling activities were placed into Department of Transportation (DOT) approved 55-gallon drums and labeled and staged on-Site for subsequent disposal off-Site or reuse on-Site; and
- Disturbance of the existing surface geomembrane and perimeter Site fence was minimized during this fieldwork, and repaired upon completion, as necessary.

Overall, the subsurface conditions encountered within borings RD-1 thru RD-5 were consistent with the general Site stratigraphy, as described during the previous subsurface investigations at the Site (Dames and Moore, 1988-1990; Golder, 1997).

All fieldwork was conducted in accordance with the Health and Safety Plan (HASP) presented in the approved RDWP (Golder, 2005), and under direct observation by Golder representatives. Golder personnel maintained field boring logs, visually classified collected soil samples, recorded sample recoveries and SPT/PID values, noted field observations related to drilling activities, and communicated field issues to Golder's designated Remedial Design Project Manager.

2.3 Peach Island Creek Channel Investigation

As part of the PDI investigations, approximate sediment levels within Peach Island Creek were measured at six (6) Sediment Survey Points (SSP) along the existing sheet pile wall to determine the elevation of the channel "mud-line" (i.e., initial/first point of noticeable resistance) and "firm-bottom" (i.e., point of physical resistance or refusal). Locations of the sediment survey points are shown in Figure 3.

To obtain these sediment level measurements, a modified staff gauge, constructed out of a 2-inch-diameter PVC pipe section with its bottom capped, was used, and approximate "mud-line" and "firm-bottom" depths were measured to an accuracy of about 0.1 feet.

In summary, these sediment survey measurements were as follows:

SSP	Approx. Horizontal Distance from Sheet Pile Wall (inches)	Approx. Depths (feet) to	
		"Mud-Line"	"Firm-Bottom"
1	20	4.9	5.1
2	28	4.9	5.1
3	25	4.7	4.8
4	32	4.6	4.6
5	28	4.2	4.4
6	25	4.3	4.4

The above depths were recorded relative to the top of the adjacent steel sheet pile wall. Measurements were made about twenty (20) to thirty-two (32) inches in front (i.e., waterward) of the existing sheet pile wall, and the average offset distance was about twenty-six (26) inches.

The scope of these PDI investigations did not include the identification and/or delineation of any potential off-Site contamination within Peach Island Creek, as this area is being addressed separately by agreement with USEPA.

2.4 Geotechnical Laboratory Testing

All collected “disturbed” and “undisturbed” soil samples were transported to Golder’s geotechnical laboratory in Cherry Hill, New Jersey, and selected soil samples were further examined, classified, and tested.

In summary, the following geotechnical laboratory tests were performed:

Geotechnical Laboratory Test	ASTM Reference	No. Tests
Moisture Content	D-2216	80
Atterberg Limits	D-4318	16
Particle Size Analysis (w/ hydrometer)	D-422	9
Particle Size Analysis (w/o hydrometer)	D-422	12
1-D Consolidation (w/ extra reload/unload cycle)	D-2435	6
1-D Consolidation (w/o extra reload/unload cycle)	D-2435	2
Unconsolidated/Undrained Tri-axial Shear	D-2850	8

Geotechnical laboratory testing results are presented in Appendix B.

2.5 Topographic Base Map

As part of the PDI, a new aerial survey flyover of the Site was performed on December 8, 2005, and an updated topographic base map for the Site, including property boundaries, was prepared, based on this new aerial survey (see Figure 3).

Horizontal survey coordinates are in accordance with North American Datum of 1983 (NAD83), and the vertical survey datum is the National American Vertical Datum of 1988 (NAVD88), which is about 1.1 feet below the National Geodetic Vertical Datum of 1929 (NGVD29).

2.6 Wetlands Delineation

A specialty wetlands consultant, Amy S. Greene Environmental Consultants, Inc. (ASGECI), was retained to provide expertise regarding applicable state and federal regulations related to wetlands and to evaluate the need for any required wetlands delineations.

The proposed OU-2 Remedy will not involve any filling or other improvements “waterward” of the existing Peach Island Creek steel sheet pile wall/bulkhead. Given that all proposed OU-2

Remedy construction activities will be confined to areas "landward" of the existing Peach Island Creek steel sheet pile wall/bulkhead, ASGECI established that a wetlands delineation was not required, because no state or federally regulated wetlands or open water will be disturbed as a result of the proposed OU-2 remedial action.

ASGECI's report establishing that a wetlands delineation is not required and that no state or federally regulated wetlands or open water will be disturbed, as a result of the proposed OU-2 Remedy, is presented in Appendix C.

3.0 FINAL REMEDIAL DESIGN

3.1 Overview

The OU-2 Remedial Action will be the final remedy to address the fill and shallow groundwater at the Site, and the major components of the OU-2 Remedial Action are as follows:

- Removing the existing, interim geomembrane barrier, and installing a new cover system over the entire area circumscribed by the existing soil-bentonite slurry wall;
- Installing a new sheet pile wall between the existing sheet pile and perimeter slurry walls along Peach Island Creek. Once this new sheet pile wall is installed, the existing sheet pile wall and the soil materials between the sheet pile walls will be removed from the top of the existing sheet pile wall down to about the low water level of Peach Island Creek;
- Remediating the designated "Hot Spot" area utilizing a combination of In-Situ Air Stripping (ISAS) and In-Situ Soil Stabilization (ISS) treatment methods; and
- Decommissioning, removing, and off-site disposal of the existing groundwater recovery system and interior piezometers/wells, and the installation of a new perimeter groundwater recovery system and associated network of piezometers to ensure that inward groundwater gradients are maintained, as per the ROD.

Subsequent sections of this FDR further describe each of the above identified major design elements, and the anticipated sequence of construction is discussed with Section 4.0 of this report. In particular, the following sections provide additional details relative to: a) geologic and hydrogeologic conditions; b) design parameters; c) soil cover system; d) stream bank enhancements; e) in-situ "Hot Spot" treatment; and f) the enhanced groundwater recovery system.

3.2 Geologic, Chemical and Hydrogeologic Conditions

Previous on- and off-property investigations (Dames and Moore, 1988/1989/1990; Golder, 1997) indicate that the general Site stratigraphy consists of the following geologic units, in descending depth order:

- **Historic "Man-Made" Fill:** consisting of highly heterogenous mixtures of clays, silts, sands, gravels, generally containing abundant amounts of large debris. Thicknesses vary from three (3) to greater than twelve (12) feet across the Site;
- **Meadow Mat and Peat:** consisting of highly compressible fibrous peat intermixed with organic silts and clays. Thicknesses vary from zero (0) to seven (7) feet across the Site;

- **Marine Deposits:** consisting of organic grey fine sand and silt. This stratum is fairly uniform across the entire Site with a thickness of about two (2) feet;
- **Glaciolacustrine Deposits:** consisting of an upper varved clay and a lower massive red clay. Thicknesses vary from zero (0) to thirty (30) feet across the Site;
- **Glacial Till:** consisting of highly heterogenous mixtures of boulders, cobbles, gravel, sand, silt and clay. Thicknesses of this stratum are variable across the Site ranging from about zero (0) to thirty (30) feet; and
- **Bedrock:** Comprised of the Brunswick shale formation. Depths to bedrock vary from about forty (40) to sixty-five (65) feet bgs across the Site, and was typically encountered at about sixty (60) feet bgs across a majority of the Site.

During previous investigations, numerous chemical constituents were detected within the fill materials, including volatile organic compounds (VOCs) such as benzene, tetrachloroethylene and toluene; semi-volatile organic compounds (SVOCs) which were generally polynuclear aromatic hydrocarbons (PAHs); a small number of pesticides such as aldrin and dieldrin; polychlorinated biphenyls (PCBs); and metals such as copper and lead.

In addition, a localized sludge "Hot Spot" area is located within the eastern corner of the Site (see Figure 3). This area covers about four-thousand (4,000) square-feet in area and consists predominantly of sludge materials and fine-grained soils with little debris beneath a surficial layer of fill, approximately 0.5 to 8 feet thick.

The volume of this sludge "Hot Spot" was estimated to be about fifteen-hundred (1,500) cubic-yards, and includes some of the highest VOC and PCB concentrations detected anywhere across the Site. Per the FFSI, VOC, SVOC, and PCB levels within the designated "Hot Spot" area are as follows:

- VOCs ranged from 1,765 to 36,320 ppm;
- SVOCs ranged from 15 to 1,327 ppm; and
- PCBs ranged from 210 to 15,000 ppm.

See Figures 3 and 8 for the limits of the designated "Hot Spot" area, which was defined during the FFSI (Golder, 1997). Tables from the FFSI which detail the depth of samples and concentrations found in the boreholes shown in Figures 3 and 8 can be found in Tables 2 and 3A-3E at the end of this report. For additional information and details with respect to the horizontal and vertical variations in contamination within the designated "Hot Spot" treatment area, see the FFSI Report.

The Site is underlain by the following three (3) groundwater units, in descending depth order:

- **Shallow Aquifer:** which consists of the water-bearing Fill stratum above the underlying clay layers;
- **Glacial Till Aquifer:** which consists of the water-bearing unit within the underlying Glacial Till stratum (between the glaciolacustrine clay layers and bedrock); and
- **Bedrock Aquifer:** which is used regionally for potable and industrial purposes.

3.3 Design Parameters

3.3.1 100-year and 500-year Flood Elevations

To establish 100-year and 500-year flood elevations, Golder obtained copies of the Flood Insurance Study (FIS) and associated Flood Insurance Rate Maps (FIRM) for the Site. For the Site, Golder established that the following flood elevations should be used for the proposed OU-2 remedial design (see Appendix D):

- **100-year Floodplain Elevation:** El. +8.3 feet (NGVD29), or El. +7.2 feet (NAVD, 1988)
- **500-year Floodplain Elevation:** El. +8.7 feet (NGVD29), or El. 7.6 feet (NAVD, 1988)

[Note: the above elevations were presented on the FIRM maps with respect to the National Geodetic Vertical Datum of 1929 (NGVD29), which is 1.1 feet above the North American Vertical Datum of 1988 (NAVD88).]

See Figure 3 for 100-year floodplain and 500-year floodplain elevation contours across and within the vicinity of the Site.

3.3.2 Floodplain Assessment

Based on the 100- and 500-year flood elevations shown on Figure 3, the majority of the Site resides within both the 100-year floodplain and 500-year floodplain. In particular, the entire Site is surrounded by areas within the floodplain, with only two (2) isolated areas that are above the 100- and 500-year flood elevations (see Figure 3).

Figure 4 shows the proposed Site grading contours for the OU-2 Remedy, and the limits of the new cover system, which will cap an area of about six (6) acres. The majority of this capped area will reside beneath the 100- and 500-year flood levels.

Clean fill materials will be used to grade the Site and construct a required new cover system, and a majority of this fill will be placed within the 100-year floodplain and 500-year floodplain limits, as shown in Figure 3.

Currently, it is estimated about 22,000 cubic-yards of imported fill will be required to construct the planned cover system, with about 16,000 and 18,000 cubic-yards placed within the vertical projection of the 100- and 500-year flood levels respectively.

Given the volume of fill placement is low relative to the larger surrounding floodplain areas and flood levels within the vicinity of the Site are not only controlled by Peach Island Creek, which is interrelated with the larger Berry's Creek drainage basin, and therefore tidally influenced, it is anticipated that construction of the required new cover system should have minimal impacts on the overall surrounding 100- and 500-year flood elevations.

3.3.3 Geotechnical Design Parameters

For the OU-2 remedial design, Golder established geotechnical design parameters based on the following:

- Soil descriptions and SPT N-values presented in the boring logs;
- Results of the geotechnical laboratory testing performed on selected "disturbed" and "undisturbed" soil samples collected during the PDI;
- Typical design values for similar materials, as presented in published literature; and
- Golder's knowledge, experience and judgment on similar projects within similar geologic materials.

See Table 1 for a summary of geotechnical design parameters, which were incorporated into the requisite design analyses and evaluations.

3.4 Cover System

3.4.1 Overview

A new cover system will be installed over the entire Fill Area circumscribed by the existing perimeter slurry wall (see Figures 3 and 4). This cover will consist of a 2-foot-thick "double containment" cap system, designed, constructed and maintained to meet the requirements of the Resource Conservation and Recovery Act (RCRA) Subtitle "C" (40CFR264.310) requirements.

Per the ROD, two (2) different cap design sections were identified: a) a vegetated surface option; and b) an asphalt surface option. The basic components for each of these preliminary cap design sections include: 1) a prepared subgrade; 2) a drainage layer; 3) and a "double containment" barrier system, described as follows:

- In the vegetated surface option, the two (2) required containment layers are established by the installation of a geomembrane overlying a geosynthetic clay layer; and
- In the asphalt surface option, the two (2) required containment layers are established by the installation of a geomembrane beneath an asphalt layer.

After evaluating these two (2) cap options, the vegetated cap option was selected, because it will provide more flexibility for potential (i.e., future) beneficial reuse and be less costly to install. Furthermore, it should be noted that pavement surfaces could be constructed in the future atop the selected vegetative cap system as part of Site development to accommodate potential future beneficial Site re-uses, as necessary.

Construction of the proposed cover system will be critical to the successful execution and completion of the OU-2 Remedy. Hence, the Remedial Contractor will be required to integrate and sequence its operations to ensure that the design and construction objectives for the OU-2 Remedy are achieved.

See Section 4.0 herein for additional information with respect to the anticipated sequence of construction.

3.4.2 Cap Design

3.4.2.1 Cap Section

The recommended vegetated cap option cross-section includes (from bottom to top) the following:

- **Grading Layer:** grading fill, as and where needed, will be placed to attain the required slopes and provide for a stable base for subsequent cap system components;
- **Geosynthetic Clay Layer (GCL):** a GCL will be placed over the grading layer to provide a low hydraulic conductivity barrier;
- **Geomembrane Layer:** a 40 mil (min.) High Density Polyethylene (HDPE) geomembrane, or equivalent, will be placed over the GCL to provide a second low hydraulic conductivity barrier;
- **Drainage Layer:** a geocomposite drainage layer, or equivalent, will be placed over the geomembrane layer to provide filtration and lateral drainage;
- **Cover Layer:** a 1.5-foot-thick (min.) soil cover will be placed over the drainage layer to protect the underlying geomembrane and drainage layers; and
- **Vegetative Layer:** a 6-inch-thick (min.) of material capable of sustaining vegetation (i.e., topsoil) will be placed over the cover layer, which will be seeded and fertilized to establish a vegetative cover to control erosion of the cap.

Construction of the proposed cover system will require the import of additional fill materials, and the Technical Specifications require the selected Remedial Contractor to deliver only certified "clean" materials to the Site. See Section 5.0 herein for additional information with respect to the Technical Specifications for the OU-2 Remedy.

3.4.2.2 Cap Grading

The Site has existing slopes ranging from about one (1) to five (5) percent, with the exception of a mounded area located in the Northeast corner of the Site (see Figure 3). A high point is located within the central portion of the Site, and surface water runoff currently flows radially from this high point to the existing perimeter drainage channels, which discharge directly into Peach Island Creek through a series of six (6) weirs notched in the tops of the existing steel sheet pile wall.

The proposed cap grading would be designed to maintain the same or similar drainage patterns, which have proven to be able to accommodate stormwater runoff over the fourteen (14) years, with radial drainage from the central portion of the Site to new perimeter drainage channels, which will discharge directly into Peach Island Creek through a series of six (6) weirs in the top of the new steel sheet pile wall.

The proposed Site grading for the OU-2 Remedy includes minimum slopes for the final cover of two-point-five (2.5) percent to promote positive drainage and allow for future cap settlements, as described in Section 3.4.2.4, over the design life of the proposed cap. Based on veneer (i.e., internal) stability analysis of the proposed cap, as described in Section 3.4.2.3, the maximum slope, within the cap area, will be ten (10) percent.

The proposed cap will extend, at a minimum, to the limits of the existing slurry wall, and the limits of the new geomembrane will generally coincide with the limits of the existing geomembrane barrier (see Figure 4). The cap will extend beyond these limits in some areas to facilitate construction and provide transitions to the natural topography.

See Figures 4 and 5 for the proposed grading and drainage plan for the OU-2 Remedy, and associated construction details for the proposed new cap, respectively.

Cap construction activities will include clearing, grubbing and stripping the Site of existing vegetation, removing the existing geomembrane, and grading to create uniform working surfaces.

It is envisioned that the existing mounded area within the Northeast corner of the Site will be re-graded, but not until after the required in-situ "Hot Spot" treatment activities have been completed. After grading, the Site will be proof-rolled to prepare the subgrade for cover construction. Grading operations will be minimized to the extent practical, so as to limit disturbance of the existing ground surface.

Materials excavated during the proposed stream bank enhancement and groundwater recovery system construction activities, and soil cuttings (i.e., investigation derived wastes) from previous soil borings and well installations on-site, will ultimately be used as grading fill beneath the new

cap, provided these materials meet the Technical Specification requirements. Additional "clean" fill materials will be imported, as necessary, to establish the required subgrade levels.

3.4.2.3 Internal Stability

The proposed cap must possess sufficient internal shear strength to be stable and retain its integrity. Fundamental to the stability of caps are the shear strength between the various geosynthetic and soil layers, and the internal shear strength of the soil layers and the GCL.

The internal (i.e., veneer) stability of the proposed cap was calculated assuming drained conditions in the drainage layer above the geomembrane with the addition of a uniformly applied equipment design load across the entire cap surface. In addition, a "rapid drawdown" design scenario was analyzed to evaluate the impacts of possible future Site flooding. Calculations presented in Appendix E, based upon an assumed shear strength of the cap system represented by an internal friction angle of 25.3° , indicate that at least a factor of safety of 2.1 is achieved for the maximum (i.e., worst case) design slope of ten (10) percent.

It should be noted this assumed minimum friction angle of 25.3° is generally considered to be a conservative figure that is less than typical levels for similar materials, based on published data, and previous testing results. The Site-specific computed factor-of-safety noted above exceeds USEPA guidance, which recommends a minimum factor-of-safety of 1.5 for soil cover systems.

To ensure that minimum shear strength requirements are satisfied for the final cap, laboratory testing of actual geosynthetic and soil materials used to construct the cap will be performed during construction, in accordance with ASTM D5321.

3.4.2.4 Settlement

Construction of the proposed new cap will result in the existing Site grades being raised between two (2) to four (4) feet, which will increase the stresses and pore water pressures within the underlying soil deposits and result in additional time-dependent consolidation settlements.

As presented in Section 3.2 herein, the Site is underlain by several compressible soil deposits, which may impact the design and serviceability of the new cap system. However, the underlying

Meadow Mat and Peat layer represents the greatest settlement concern, due to its highly compressible nature and variable thickness across the Site.

Design calculations indicate total settlements across the Site may vary from about six (6) to twenty-four (24) inches over a span of fifty (50) years, and the underlying Meadow Mat and Peat layer accounts for four (4) to sixteen (16) inches of this total settlement value (see Appendix E). Given that the Meadow Mat and Peat layer is spatially inconsistent (varying from 0- to 7-feet-thick over relatively short distances), it is difficult to evaluate the degree and magnitude of differential settlements across the Site.

Furthermore, the O&M Plan for the OU-2 Remedy will incorporate provisions for the routine inspection of the new cover system, and if any future settlement of the new cap results in localized areas of ponding, due to insufficient drainage, appropriate corrective actions will be implemented to correct these future field conditions, per the O&M Plan for the OU-2 Remedy.

3.4.2.5 Frost Penetration

Geomembranes do not need to be placed below the frost zone according to published data on low temperature performance of geomembranes (Mills and Budiman, 1991; Peggs et al., 1991). In general, samples tested at low temperatures show an increase in tensile strength and decrease in strain at failure compared to samples tested at ambient temperature. However, even under low temperatures, failure strains are still on the order of those typical for ductile materials. Hence, low temperature embrittlement of geomembranes (GM) is not a design concern.

This conclusion is consistent with USEPA guidance, which indicates that neither "GCLs nor GMs appear to be vulnerable to freeze-thaw damage." Furthermore, potential concerns regarding possible desiccation or degradation of the proposed GCL, due to frost, can be effectively addressed by covering the proposed GCL with a geomembrane (USEPA, 2002), as proposed by this PDR.

Although the proposed geomembrane itself will not be affected by freezing, there is a potential for objects, below the geomembrane, being uplifted due to frost heave action, if the frost penetrates below the geomembrane. The potential for uplifted objects damaging the installed geomembrane barriers will be mitigated by removing any exposed rocks and/or other sharp objects and proof-rolling the subgrade surfaces to prevent them from contacting the new geomembrane. Additionally,

the use of grading fill materials, which are relatively free of rocks and large particles, under the proposed GCL will further protect the proposed cap from adverse impacts due to uplift.

To protect the cap edges from adverse impacts due to freezing of moisture within the drainage layer, toe drains will be incorporated into the proposed remedial design. The cover soil and topsoil at these toe drains will be replaced with riprap materials, providing a free-draining material to convey the infiltration intercepted by the drainage layer (see Figure 5).

3.4.2.6 Infiltration

One of the primary objectives for capping the Site is to control surface water infiltration into the underlying fill materials. The Hydrologic Evaluation of Landfill Performance (HELP) model was used to evaluate the infiltration reduction capability of the proposed cap. The HELP model was used to evaluate final conditions (after placement of the proposed cap and establishment of vegetation) for the minimum and maximum design slope inclinations, which are two-point-five (2.5) and ten (10) percent, respectively.

The HELP model, developed by the U.S. Army Corps of Engineers Waterways Experiment Station, is a quasi two-dimensional hydrological model of water movement across, into, through, and out of landfills. This model accounts for climatological and cap design data and utilizes a solution technique to conduct a water balance in terms of surface storage, runoff, infiltration, percolation, evapotranspiration, soil moisture storage and lateral drainage.

The impermeability characteristics of a geomembrane are superior to a low permeability soil layer. For example, based on water vapor transmission tests performed by manufacturers and Koerner (1990), the permeability of HDPE geomembranes ranges from 1×10^{-10} cm/sec to 1×10^{-14} cm/sec. Therefore, a permeability design value of 1×10^{-11} cm/sec was assumed for the proposed geomembrane in the HELP analyses. Additionally, a permeability design value on the order of 5×10^{-8} cm/sec was assumed for the proposed GCL, which is generally considered to be an upper bound for typical GCLs.

The HELP model used synthetically generated precipitation data for the Site, based on the closest city/town within the HELP database: Newark, New Jersey. The average annual rainfall used by the HELP model was 41.7 inches.

Golder evaluated four (4) cap system design scenarios using the HELP model, and these analyses indicate infiltration through the final cap system (i.e., recharge) would be 0.00002 inches-per-year (see Appendix E of the PDR), which is equivalent to 3.26 gallons-per-year infiltrating through the cap system (based on a Site area of about 6 acres) (See Appendix E).

The HELP model analyses shows post-capped conditions should practically eliminate infiltration into the underlying Fill stratum, reducing it by at least 99.9%¹ to an estimated infiltration on the order of three (3) gallons-per-year for the entire Site.

3.4.2.7 Drainage Layer

The purpose of the drainage layer is to convey water infiltrating the vegetative and soil cover layers to an outlet to minimize the time water is in contact with the geomembrane, and to reduce the hydraulic head over the geomembrane, thereby reducing the potential for sloughing and instability of the overlying soil layers.

Two (2) types of drainage materials were considered for the Site-specific conditions: a) an 18-inch-thick layer of uniformly graded, well draining sand; and b) a geocomposite drainage layer, consisting of a HDPE drainage net (i.e., geonet) with a non-woven geotextile heat-bonded to one or both sides of the geonet. Of these two (2) drainage layer alternatives, the geocomposite drainage layer will satisfy the design requirements, and will likely be less costly.

The HELP model results (see Appendix E) were used to estimate the maximum head over the proposed geomembrane. The model results indicate that, with a geocomposite drainage layer, the maximum hydraulic head from a peak daily storm event will be about twenty (20) inches above the geomembrane, based on the critical flow path of a two-point-five (2.5) percent slope for a maximum length of two-hundred-forty (240) feet. Where slope inclinations average about ten (10) percent over a drainage path of one-hundred-twenty (120) feet, the HELP model indicates that a maximum peak daily hydraulic head of five (5) inches is expected using a geocomposite.

¹ The reduction in recharge was based on the estimated amount of infiltration through an uncapped condition (i.e., soil) compared to the HELP model results for the proposed impermeable (i.e., geosynthetic) cap systems. For example, assuming zero surface water runoff (i.e., 100% infiltration), the reduction in recharge equals 99.99995%. Assuming 80% surface water runoff (i.e., only 20% infiltration), the reduction in recharge is still greater than 99.9% (i.e. 99.99976%).

Therefore, the HELP model results indicate that the proposed vegetative cover system will not become fully submerged, and risks associated with potential veneer slope failures should be minimal under these conservative (i.e., worst case) design conditions.

3.4.2.8 Vegetative Layer

The primary purpose of the vegetative layer is to simply support vegetation, since a good stand of vegetation will reduce the potential for erosion, thus protecting the entire final cap. Excessive erosion creates significant maintenance problems, and is also a factor in assessing the adequacy of the thickness of the surface soil, which protects the underlying cap layers. Therefore, the cap must be evaluated on the basis of potential soil loss from vegetated slopes.

The principal cause of erosion is rainfall and runoff, and the resulting erosion can be estimated using the Universal Soil Loss Equation (USLE), which was developed to estimate long-term average annual soil loss (USEPA, 1989). The factors that affect soil erosion, as used in the USLE, are the soil erodibility, slope length and steepness, and cover management practices. These factors are dependent upon the location of the Site, the cover soil type, and the inclination of the final cap.

Using the USLE, the average annual soil loss for the “worst-case” combination of slope length and steepness (i.e., one-hundred-twenty (120) feet at ten (10) percent plus one-hundred-twenty (12) feet at three (3) percent slope grades) was computed to be about 0.26 tons-per-acre-per-year, which is well below the typical allowable rate of 2.0 tons-per-acre-per-year (see Appendix E of PDR). Furthermore, the average annual soil loss for the typical combination of slope length and steepness, as shown on Figure 4, (i.e., two-hundred-forty (240) feet at two-point-five (2.5) percent slope grade) was computed to be about 0.075 tons-per-acre-per-year (see Appendix E herein).

For the typical slope configuration shown on Figure 4, the average annual depth of erosion based on the calculated annual soil loss is about 0.000029 feet-per-year. Therefore, the proposed cover soil thickness is considered adequate from an erosion perspective.

3.4.3 Surface Water Management

Currently, a natural drainage divide traverses the Site in an East-West direction, approximately in the middle of the Site. Surface water runoff from the West, South and Eastern portions of the Site

drains via perimeter channels to Peach Island Creek, while surface water from the Northern portion of the Site drains directly into Peach Island Creek.

It is envisioned that the existing perimeter drainage channels will be upgraded, but will continue to discharge into Peach Island Creek. See Figures 4 and 5 for proposed grading and drainage plan and details for the OU-2 Remedy. See Appendix E for associated stormwater management design computations.

3.4.4 Temporary Erosion and Sediment Control Measures

Temporary erosion and sediment control measures, which will meet the minimum requirements of the "Standard for Soil Erosion and Sediment Control in New Jersey" (2005), will be implemented during construction by the selected Remedial Contractor.

General details and specifications have been incorporated into the construction drawings and Technical Specifications for the OU-2 Remedy for standard erosion and sediment control features, which include silt fences, hay bales, diversion channels, and/or temporary diversion berms. See Figures 6 and 7 for the layout and typical details for the anticipated soil erosion and sediment control measures.

Prior to any ground disturbance, the selected Contractor will be required to submit its own Erosion and Sediment Control Plan, which must comply with the project Technical Specifications and be consistent with the Contractor's planned sequence of construction activities.

3.5 Stream Bank Enhancements

3.5.1 Overview

During the OU-1 construction, a steel sheet pile wall was installed along Peach Island Creek to facilitate construction of the existing slurry wall. During construction of the slurry wall, it appears that sections of this sheet pile wall moved (i.e., translated and/or rotated) under the applied construction loading conditions, and a series of steel H-piles (driven into the underlying Glacial Till stratum) were installed in front (i.e., "waterward") of the sheet pile wall to serve as stiff buttress supports and stabilize the wall.

To investigate the integrity of the sheet pile wall, the wall was monitored during the FFS phase of the project. In general, the wall has rotated about ten (10) to thirty (30) degrees from vertical over a significant portion of its length. No substantive movements have occurred since the OU-1 construction was completed, but the wall is considered to be only marginally stable under current loading conditions.

One of the primary remedial action objectives for OU-2 is to implement stream bank enhancements to establish a long-term, permanent solution resulting in a more stable and aesthetically pleasing stream bank condition.

The OU-1 "as-built" construction drawings indicate that the existing steel sheet pile wall is offset about ten (10) to twenty-five (25) feet "waterward" of the existing slurry wall centerline, with slurry wall widths at the ground surface varying from about five (5) to fifteen (15) feet.

Therefore, it appears the existing steel sheet pile wall is typically offset about six (6) to twelve (12) feet from the nearest (i.e., "waterward") side of the slurry wall. Proposed stream bank improvements will be constructed within this area to prevent impacts to, and encroachments into, Peach Island Creek.

3.5.2 Performance Criteria and Standards

Improvements and/or upgrades to the existing steel sheet pile wall/bulkhead must take into consideration the stability/integrity of the existing slurry wall, and the design evaluations must consider both short-term (i.e., construction) and long-term conditions.

Design of proposed stream bank enhancement remedies will follow generally accepted geotechnical engineering design practices and procedures, as typically described in, but not limited to, the Naval Facilities Design Manuals DM-7.01 and 7.02.

In summary, design of the proposed stream bank enhancements considered the following evaluations and corresponding design criteria:

- *Slope Re-Configuration and Stability:* These design evaluations assessed both short-term (i.e., construction) and long-term design conditions, in order to achieve minimum short- and long-term design factors-of-safety of 1.3 and 1.50, respectively; and

- ***Earth Support Structures:*** These design evaluations considered the design and construction of structural retaining wall systems (e.g., gravity, segmental, cantilevered and steel sheet pile wall systems). These systems would be designed using static equilibrium methods, and incorporate appropriate factors-of-safety to maintain static equilibrium.

All geotechnical engineering design evaluations and/or calculations incorporate the various design parameters corresponding to the underlying geologic materials, as presented in Table 1.

3.5.3 Geometric Design Constraints

Based on the proposed new cap thickness of twenty-four (24) inches and current ground surface deviations, the proposed final grades along the existing slurry wall alignment vary from about elevation El. +4.0 to El. +6.5 (NAVD, 1988).

Based on the OU-1 “as-built” construction drawings (Canonie, 1992), the existing steel sheet pile wall was installed with a top elevation of El. +3.5 (NGVD, 1929), which translates into a top elevation of about El. +2.4 (NAVD, 1988).

Based on information collected during the PDI, “firm-bottoms” in front of the existing sheet pile wall were estimated to vary from about 4.5 to 5.0 feet beneath the top of the existing sheet pile wall, corresponding to elevation ranging from El. -1.9 to El. -2.4 (NAVD, 1988).

Therefore, the elevation rise (height above “firm-bottom” to the adjacent final proposed grades) is estimated to be about six (6) to nine (9) feet requiring slopes with inclinations varying from about 1.33:1.0 (H:V) to 1:1 (H:V), given the existing sheet pile wall is offset “waterward” six (6) to twelve (12) feet from the existing perimeter soil-bentonite slurry wall.

See Appendix F for additional information regarding the geometric design constraints, and representative cross sections through the existing slurry and sheet pile walls.

3.5.4 Stream Bank Improvement Design

To establish the maximum design slope inclination for the proposed stream bank improvements, “global” slope stability analyses for typical slope configurations were completed (see Appendix

F), and the results of this analysis indicate that the maximum design slope should not be steeper than 4:1 (H:V).

Based on these stability calculations, approximately twenty (25) to forty (40) feet would be required to create a stable slope configuration between the existing slurry wall and the creek. However, the typical offset distance available is only about six (6) to twelve (12) feet, as previously noted. Therefore, the proposed stream bank improvements will require a new earth supporting structure (i.e., gravity or sheet pile walls).

To select a preferred support system, various types of gravity wall systems (i.e., cast-in-place cantilevered concrete retaining walls, gabion walls, segmental block wall, and pre-cast concrete "bin" walls) were considered, but all of these systems would also require a new temporary sheet pile wall to protect the existing slurry wall during construction of the permanent wall.

Alternatively, a new steel sheet pile wall could be installed as a permanent replacement for the existing sheet pile wall, and this approach has the following advantages:

- It would cost less;
- It would maintain the integrity of the existing sheet pile wall; and
- It would serve to provide a further lateral hydraulic containment barrier.

Therefore, the preferred stream bank improvement option for the OU-2 Remedy includes a new steel sheet pile wall located about five (5) feet behind (i.e., "landward" of) the existing sheet pile wall. See Appendix F for design calculations for the proposed new steel sheet pile wall. See Figures 13 and 14 for the proposed steel sheet pile wall plan and details.

In addition, once the new steel sheet pile wall is in-place, the existing fill materials between the new and old sheet pile walls will be removed, and the existing sheet pile wall and its associated H-piles buttresses will be removed by cutting these elements at the Peach Island Creek low water level.

Excavated fill materials from between the new and old sheet pile walls will be utilized as grading fill beneath the proposed new cap, provided these materials satisfy the requirements of the Technical Specifications (see Section 5.0 herein).

3.6 In-Situ "Hot Spot" Treatment

3.6.1 Overview

One of the primary remedial action objectives for OU-2 is to reduce the toxicity and mobility of the existing sludge "Hot Spot" contaminants utilizing a combination of in-situ treatment techniques. In particular, the selected remedy for this "Hot Spot" area includes in-situ treatment using the following technologies:

- In-Situ Air Stripping (ISAS); and
- In-Situ Solidification/Stabilization (ISS).

ISAS will be used to reduce the concentration of volatile contaminants within the existing fill and sludge materials within the treatment area by enhancing the volatilization and removal of chemical constituents. This will be accomplished by mixing the existing fill and sludge materials in-place while injecting air or steam to enhance the volatilization and removal process.

The extracted off-gas will be captured, and treated using appropriate technologies (e.g., vapor phase activated carbon, thermal oxidation, catalytic oxidizers) before discharge to the atmosphere.

After ISAS activities are complete, the air stripped fill and sludge materials within the treatment zone will be solidified/stabilized, utilizing ISS methods, to reduce the mobility of the remaining chemical constituents. This will be accomplished by mixing the materials in-place and injecting admixtures (e.g., cement, lime, fly ash, or bentonite) to solidify the material into a hardened mass.

The limits of this designated "Hot Spot" treatment area were previously investigated and delineated during the FFSI, and the results of this study were presented in the FFSI Report (Golder, 1997). In summary, the FFSI confirmed the presence of a discrete area of sludge within the Eastern portion of the Site with the following general characteristics:

- The sludge “Hot Spot” area is about four-thousand (4,000) square-feet in aerial extent, and the materials within this area are predominately comprised of sludge material and fine-grained soil with little debris;
- A surficial layer of fill, about 0.5 to 8 feet thick, overlies the sludge material, and the sludge volume was estimated to be about fifteen-hundred (1,500) cubic-yards; and
- The chemical characteristics for the sludge material within this area include the highest VOC and PCB concentrations detected anywhere on-site. In particular, total VOC concentrations ranged from 1,765 mg/kg (ppm) to 36,320 mg/kg (ppm), and PCB concentrations ranged from 210 mg/kg (ppm) to 15,000 mg/kg (ppm).

See Figures 3 and 8 for horizontal/vertical limits and representative cross-sections through the designated “Hot Spot” treatment area.

To evaluate the possibility of reducing the toxicity and mobility of the sludge “Hot Spot” area, a “bench-scale” laboratory treatability study (Kiber, 2000) was conducted, as part of the USEPA approved FFS for OU-2, with the following objectives:

- Evaluate the effectiveness of ISAS for reducing VOC concentrations prior to introduction of the various solidification/stabilization reagents;
- Evaluate variations in the amount (i.e., proportions) of reagent materials (i.e., cement, lime, bentonite, and fly ash) to facilitate establishment of “Design Mixes”;
- Evaluate the reduction in total constituent concentrations and constituent mobility for various design mixes; and
- Evaluate whether the addition of zero-valent iron would provide additional treatment of chlorinated organics.

The findings, conclusions and results of this treatability study were presented within the FFS (Golder, 2001), and are summarized as follows:

- Average total VOC concentration of the treatability samples was 29,714 mg/kg (ppm);
- During the air-stripping phase, total VOC concentrations were reduced from 26,673 mg/kg (ppm) to 2,562 mg/kg (ppm), which represents a factor of more than ten (10);
- Solidification/stabilization tests indicated substantial reductions in PCB and VOC concentrations and leachability were achieved when a 10% cement and 10% lime mixture (by weight) was utilized; and

- After introduction of the solidification/stabilization reagents, unconfined compression strengths were measured at between twenty-three (23) to forty-nine (49) pounds-per-square-inch (psi), which were well above the fifteen (15) psi study goal. This will be suitable for (limited) future re-uses of the Site.

Based on this treatability study, the remedy selected in the ROD is in-situ treatment of the sludge "Hot Spot" area utilizing a combination of ISAS and ISS techniques.

The selected Remedial Contractor will be responsible for the detailed design of the In-Situ "Hot Spot" Treatment work, and compliance with the Technical Specification minimum design requirements and performance and quality control requirements.

The following sections of this FDR further describe the conceptual design of the proposed in-situ "Hot Spot" treatment.

3.6.2 Performance Criteria and Standards

In the Technical Specifications (see Appendix G), ISAS and ISS activities are incorporated under a single, combined performance-based Technical Specification, which will allow the selected Remedial Contractor some degree of flexibility during its design and implementation of the proposed work.

The Technical Specifications require collection of post-treatment (i.e., upon completion of ISS operations) samples for quality control testing, and the average values of the combined post-treatment test results will be used to evaluate the overall performance and success of the combined ISAS and ISS operations.

Per the ROD and Consent Decree, average post-treatment total VOC levels, within the treatment zone, are to be reduced to whichever is most stringent of the following three (3) performance criteria:

- a) 90% lower than pre-treatment levels;
- b) Below the average VOC levels within the fill outside the "Hot Spot" area; or
- c) A level where interferences with stabilization will not occur.

To evaluate Criteria "a" (as defined above), Golder reviewed the total VOC data presented in the FFSI (Golder, 1997) and FFS treatability study (Kiber, 2000), and it appears the total VOC concentrations within the sludge "Hot Spot" area average about 20,600 mg/kg (ppm). Therefore, a 90% reduction in total VOC, within the treatment zone, would be represented by an average of about 2,060 mg/kg (ppm).

To evaluate Criteria "b" (as defined above), Golder reviewed the total VOC data presented in the RI (Dames and Moore, 1990), and neglecting surficial samples², the total VOC concentrations within the fill materials outside of the sludge "Hot Spot" treatment average 1,280 mg/kg (ppm).

With regards to Criteria "c" (as defined above), the FFS treatability study (Kiber, 2000) did not identify any potential conditions where the ISAS and ISS operations would interfere with each other.

Accordingly, the most stringent VOC performance criterion appears to be Criterion "b" (as defined above), and this has been used to establish the performance criteria within the In-Situ "Hot Spot" Treatment Technical Specification (see Section 02450 of the Technical Specifications, as presented in Appendix G).

The ROD also requires that in-situ soil solidification/stabilization of the sludge "Hot Spot" area achieve both of the following performance criteria:

- a) The treated mass has an average uniform unconfined compressive strength of fifteen (15) pounds-per-square-inch (psi); and
- b) The average leachability of the treated mass is reduced by 90% when compared with the pre-treatment baseline data presented in the FFS, based on the Synthetic Precipitation Leaching Procedure (SPLP) testing methods.

During the treatability study (Kiber, 2000), solidification/stabilization of contaminated sludge materials, using 10% cement and 10% lime (by weight), resulted in unconfined strengths of about forty-two (42) psi, which is well above the fifteen (15) psi performance goal. In addition, total VOC and SPLP VOC concentrations were reduced by about 95%, and SPLP PCB concentrations were also reduced by about 95%.

² Current agency guidance does not recommend relying upon VOC data collected within the zero (0) to two (2) feet depth range.

Details of the performance criteria for the "Hot Spot" treatment as dictated in the ROD are discussed in the Technical Specification (Section 02450 in Appendix G). Performance criteria include that the average VOC levels of final treated mass shall be equal to or less than 1,280 ppm; the average leachability of the treated mass shall be reduced by 90% as compared to the FFS results; and the average 28-day strength of treated mass shall be fifteen psi (min).

A detailed verification program to ensure the performance criteria are met included in the Technical Specification and includes, but is not limited to, the following tests: post-ISAS head-space sampling, post-ISS head-space sampling, mixing efficiency, post-ISS VOC testing, post-ISS leachability testing, and post-ISS strength testing.

In addition, the In-Situ "Hot Spot" Treatment Technical Specifications includes flexibility for the Remedial Contractor to develop and submit its own mix designs, and to utilize alternate proportions or types of reagents (i.e., cement, lime, bentonite, and fly ash), provided the final performance criteria/standards are achieved.

3.6.3 Field Verification Program

Given that there exists some degree of uncertainty with respect to implementation of the full-scale In-Situ "Hot Spot" Treatment methods, the associated Technical Specifications require the Remedial Contractor to undertake and successfully complete a "pilot-scale" field verification program.

The purposes of this field verification program are as follows: a) to verify that the combined ISAS and ISS operations are capable of achieving the specified performance criteria; b) to allow the Remedial Contractor some degree of flexibility to modify its proposed means-and-methods; c) to account for variations in field conditions; and d) to establish field-specific operational requirements (e.g., durations of ISAS treatment for each column).

In summary, the In-Situ "Hot Spot" Treatment Technical Specification (see Section 02450 of Technical Specifications, as presented in Appendix G herein) includes provisions for the performance of a "pilot-scale" field verification program, which includes the following requirements:

- Collect representative samples of the sludge material, and perform a treatability study to evaluate alternate mix designs, as necessary;
- Mobilize all equipment, materials and labor required for production operations. In addition, provide all monitoring equipment to be used during “full-scale” production operations;
- Perform ISAS and ISS to create at least five (5) overlapping treatment columns;
- Collect continuous VOC measurements from off-gases within the auger shrouds. In addition, collect representative post-ISAS augered soil samples, and perform field “head space” tests on these samples, which will be used as a qualitative field screening tool;
- Collect representative post-treatment (i.e., post-ISS) samples, while the treated mass is “wet”, from different depths within the treated column, allow these samples to cure on-site under representative field conditions, and test these samples for total VOC, compressive strength and SPLP on intact samples; and
- Determine whether or not the specified performance criteria/standards are achieved, based on the collected post-ISS quality control samples.

Overall, this field verification program would be used to evaluate how the primary design parameters (i.e., mixing time, air/stream temperature, and ISS reagent proportions) may need to be varied to achieve the specified performance criteria/standards.

Specifically, this “pilot-scale” field-testing program would be used to establish the minimum duration of the ISAS for each treated column, and to verify that the Remedial Contractor’s ISS design mix will satisfy the specified strength and leachability requirements.

If the post-treatment performance criteria/standards cannot be achieved, treatment may proceed but those portions of the treatment zone not satisfying the designated criteria may have to be excavated and disposed of off-Site.

3.6.4 In-Situ Air Stripping (ISAS)

The proposed ISAS methodology will utilize truck- or crane-mounted equipment with single- or double-auger systems covered by a shroud. During the mixing process, ambient air and/or steam will be injected into the soil/sludge mixture to enhance volatilization, and negative pressures will be maintained within the shroud to capture the released VOCs.

Recovered VOCs will be treated using appropriate technologies, such as thermal oxidizers, and/or vapor phase activated carbon. Section 3.6.5 includes additional details related to air monitoring, treatment and discharge requirements.

The proposed ISAS and ISS operations will extend five (5) feet horizontally and vertically beyond the limits of the sludge "Hot Spot" area, as identified in the FFSI to ensure treatment of the entire sludge area. In general, the overall treatment zone will extend to about ten (10) to eighteen (18) feet bgs.

In-situ soil mixing will be carried out utilizing an overlapping grid pattern to ensure effective treatment for VOC removal and ISS of the entire sludge "Hot Spot" treatment area. In addition, the Technical Specifications include provisions for utilizing smaller diameter augers around the perimeter of the treatment zone to mitigate interferences with adjacent fill materials and debris.

See Section 02450 of the Technical Specifications for additional information and details with respect to the proposed ISAS treatment methods.

3.6.5 In-Situ Soil Solidification/Stabilization (ISS)

Upon completion of ISAS activities at each "column" location, reagent materials will be mixed into the treatment zone in the form of slurry to solidify/stabilize the entire sludge mass. These reagent materials will be mixed into the treated sludge material using the same auger systems to achieve thorough homogenization.

Based on the treatability study (Kiber, 2000), the overall solidification/stabilization process is expected to result in an expansion of the treated volume, and it is possible this volume expansion may be as much as thirty (30) to thirty-five (35) percent. The resulting ground heave will be accommodated during the subsequent Site final grading and subgrade preparation activities.

See Section 02450 of the Technical Specifications (see Appendix G) for additional information and details with respect to the proposed ISS in-situ treatment methods.

3.6.6 Monitoring, Treatment and Discharge

As a by-product of the ISAS and ISS activities, extracted air containing elevated VOC concentrations will be generated, which will be collected and treated on-site to prevent adverse impacts on the surrounding community. The Technical Specifications require the Remedial Contractor to design, operate and maintain an air collection system at all times during ISAS operations. In addition, the Technical Specifications require continuous monitoring of both pressures and VOC levels within the auger shroud.

Ultimately, the selection and detailed design of the air treatment technology will be left to the Remedial Contractor performing the ISAS and ISS operations. However, based on discussions with qualified potential Remedial Contractors, the most likely treatment method will be either thermal oxidation or activated carbon adsorption.

The In-Situ "Hot Spot" Treatment Technical Specification (Section 02450) requires the Remedial Contractor to obtain all required Federal, State and local air emissions permits and/or certificates.

The National Emissions Standards for Hazardous Air Pollutants (NESHAP) is listed as an ARAR in the ROD. However, Golder believes the proposed ISAS operations are exempt from the NESHAP for Site Remediation, because the Site falls under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as 40CFR63.7881(b)(2), which states:

"Your site remediation is not subject to this subpart if the site remediation will be performed under the authority of the Comprehensive Environmental Responses and Compensation Liability Act (CERCLA) as a remedial action or a one time-critical removal action."

If the Remedial Contractor uses activated carbon adsorption systems, the Technical Specifications stipulate that all spent carbon materials be disposed off-site, in accordance with all local, state and federal regulations.

3.7 Enhanced Groundwater Recovery System

3.7.1 Overview

Currently, hydraulic control and containment of the Fill aquifer is being achieved by the presence of a perimeter soil-bentonite slurry-wall system, which circumscribes the Site, an interim geomembrane cover over the entire Fill area circumscribed by this perimeter slurry wall, and the O&M of an interim shallow groundwater interceptor well system consisting of pumping wells screened within the fill stratum and above-ground header piping. Extracted groundwater is conveyed from these existing wells to an on-site, aboveground storage tank, which stores the collected water until it is periodically removed and transported off-site for disposal.

To date, this interim groundwater recovery system, in conjunction with the perimeter slurry wall, has provided hydraulic source control. However, the existing groundwater recovery system cannot be efficiently operated and maintained over the entire design life of the OU-2 Remedy. Therefore, the existing system will be replaced to satisfy the identified objectives for the OU-2 Remedial Action.

The ROD envisioned that the existing groundwater recovery system would be improved/upgraded by installing new extraction wells around the perimeter of the Site, and constructing underground "clean" corridors for new piping and control systems. Toward this end, the PDR presented the design basis for improving/upgrading the existing system by decommissioning the existing system and constructing a new system consisting of horizontal trench drains and a series of groundwater collector wells.

However, in response to Agency comments, Golder re-evaluated its design, and this FDR presents a design based on a series of extraction wells instead of the collection trenches originally proposed in the PDR. This new system will use a perimeter layout of individual groundwater recovery wells with pneumatic-based controls directing recovered groundwater to an aboveground storage tank.

This new groundwater recovery system will maintain inward hydraulic gradients around the Site perimeter, as required by the ROD. Additional interior groundwater recovery wells will not be necessary for the following reasons:

- A review of historic groundwater level data for periods when the current system was not in operation indicates that there is no significant Site-wide "rebound" of groundwater levels during system shutdowns. This is likely attributable to the lack of direct infiltration recharge through the current cover at the Site and the presence of the existing slurry wall, which limits horizontal groundwater flow through the source materials. As a result, groundwater levels in the fill unit within the slurry wall have effectively stabilized;
- The new cap is designed to be even more effective in limiting direct infiltration recharge than the existing interim cover. Water balance calculations indicate that the new system will eventually dewater the interior fill unit; and
- Based on a simplified, conceptual Site model, a Site-specific numeric groundwater flow model was developed as a tool to evaluate locations, spacing, and frequency of pumping wells, as needed to maintain inward hydraulic gradients. The results of this analysis indicate that a system comprised exclusively of perimeter pumping wells will be able to maintain inward hydraulic gradients, and these results also indicate little to no groundwater mounding between pumping wells and across the central portion of the Site.

The proposed system includes the following design elements (see Figures 9 through 12 for additional details and information with respect to the proposed new groundwater recovery system):

- Install a series of 1-foot-diameter groundwater extraction wells along the Site perimeter to collect and extract groundwater using more efficient and lower-maintenance low-volume, pneumatically-controlled pumps;
- Install a filter pack surrounding each well consisting of larger-diameter filter media and in-situ clean-out ports to minimize the clogging of these extraction wells. The clean-out ports located within the filter media outside the well casing will provide additional means to surge and clean the filter pack surrounding each well in the event that the larger-diameter filter media is still prone to clogging;
- Construct underground "clean" corridors, beneath the new cover system, between the proposed extraction wells;
- Provide a series of primary carrier piping within these "clean" corridors, which will contain the required pneumatic air and groundwater discharge conveyance lines. These carrier pipes will also serve to provide secondary containment for any potential leakage, and they will be oversized to accommodate potential future system maintenance and upgrade. In addition, a redundant series of secondary carrier pipes of the same size and materials will be provided within these "clean" corridors to further provide a means to accommodate potential future system maintenance and upgrades, and these secondary carrier pipes will be capped at their respective ends; and
- Convey the extracted water from the wells to a new on-site, aboveground storage tank. The tank will be periodically evacuated and its contents disposed off-Site at licensed facilities.

Overall, the new groundwater recovery system will be more efficient and reliable than the existing system in the following ways:

- Allows for the use of more efficient, low-head, submersible pneumatic pumps;
- Mitigates the potential for pump and filter clogging;
- Eliminates the need for individual electric service to be run to each well; and
- Requires less and easier long-term maintenance, which should ensure the system remains operational over its entire design life.

The following sections further describe the design of the proposed shallow groundwater recovery/hydraulic source containment system.

3.7.2 Performance Standards and Design Criteria

In accordance with the ROD, the new groundwater recovery system has been designed such that hydraulic control is achieved by maintaining inward gradients across the existing perimeter soil-bentonite slurry wall.

To monitor both internal/external water levels and verify that the proposed system will maintain inward hydraulic gradients, the proposed design includes the addition of a series of new shallow piezometers located around the Site perimeter. These piezometers would be installed in pairs, one (1) on either side of the existing slurry wall, except on the creek side of the Site, and would be screened within the Fill stratum. In addition, in response to Agency comments on the PFDR, two interior piezometers, also screened within the Fill stratum will be installed to assess the water levels in the interior of the Site as necessary. A staff gauge will be installed in the creek adjacent to the Site in order to measure water levels outside the slurry wall on the creek side of the Site.

3.7.3 Hydraulic Source Control System Design

3.7.3.1 General

Figure 9 provides the layout of the proposed groundwater recovery system. In general, the new pumping wells will be offset about twenty (20) to twenty-five (25) feet inside of the existing slurry wall. Ten (10) 1-foot-diameter groundwater extraction wells (see Figures 9 and 10) will be installed. These wells will contain appropriately sized pneumatic pumps and associated level controls to convey the water through header pipes to a new on-site, aboveground storage tank.

To achieve the design goal, the pumps will be installed to maintain groundwater elevation inside the slurry wall of about El. +2.0 feet (NAVD, 1988), and this level can be easily adjusted in response to observed field conditions. Based on a review of the previously collected internal/external water level readings, it is anticipated this control elevation will allow the proposed groundwater recovery system to maintain internal groundwater levels, which will achieve inward hydraulic gradients along the monitored Site perimeter.

3.7.3.2 Conveyance and Control System

The proposed groundwater extraction wells will have a maximum outside diameter of three (3) feet, including a 1-foot-thick filter pack around the well casings, and will be installed at locations shown on Figure 9 to depths of about ten (10) to twelve (12) feet bgs.

The proposed extraction wells will be constructed out of HDPE, or equivalent, slotted pipes sealed using HDPE end caps (see Figure 10). Details on how the extraction wells will be installed can be found in Technical Specification #02675, entitled "Well Construction". This Specification indicates that all well installation activities will be performed in accordance with the procedures defined in N.J.A.C. 7:9. Final drilling methods will be based on the Contractor recommendation, subject to approval by the Remedial Designer. Use of mud rotary drilling techniques is not recommended, as excessive amounts of mud may be needed. The Technical Specification includes a requirement that a list of all equipment to be used for well installation, including proposed drill rigs and torque capacity, be provided by the Contractor.

A series of primary and secondary carrier pipes will also be installed within a "clean" corridor, excavated between the wells and storage tank for, to route the required compressed air (i.e., pneumatic) and groundwater discharge lines. These carrier pipes will be placed below the frost line, constructed of HDPE pipe, and will provide secondary containment for the groundwater discharge lines. See Figure 10 for typical groundwater extraction well details.

Excavated material from the well locations and from the clean corridor trenches will be used as general grading fill beneath the proposed cap, provided that the excavated material meets the Technical Specification requirements. In addition, control of water (i.e., construction dewatering) may be required during trench and well excavation activities. Any water generated during these

excavation activities will be contained and disposed, in accordance with all Federal, State, and local rules, regulations, laws and statutes.

Non-woven geotextile fabrics will line the entire trench and encase all stone/gravel filter materials to provide adequate separation barriers between dissimilar materials and to delineate the extent of the excavated "clean" corridors (see Figures 10 and 11).

Submersible pneumatic pumps will be installed within each new extraction well to convey groundwater through a common discharge (i.e., force) main to an on-site, aboveground leachate holding tank. These pumps will be pneumatically operated with built-in floats and valves to control the pumping cycle, and the activation levels of these pumps will be initially set about El. +2.0 feet, but may be adjusted in the future to account for observed field conditions.

Compressed air supply and groundwater discharge lines will be comprised of standard nitrile-constructed hosing, and utilize stainless steel hose barbs, fittings, and clamps.

For each pump, the compressed air supply hose will be 1/2-inch in diameter and be pressurized at forty (40) psi. The groundwater discharge lines will be a 1-inch-diameter hose and will be connected to a 1-inch-diameter discharge header. A typical pump cycle will displace about 0.14 gallons and consume 0.4 cubic feet/gallon of air.

Each pump will be outfitted with a cycle counter to indicate the number of pumping cycles each individual pump has completed. The cycle counters will aid in determining whether or not any given pump is not operating or if the water level in each well has stabilized.

A pneumatic pump control panel will be installed within a new pre-engineered metal storage building, and this building will be constructed such that all materials and equipment will reside at or above the 100-year flood level.

This pump control panel will supply compressed air to each of the pneumatic pumps, and will be connected to a tank-full sensor within the specified aboveground storage tank. If this sensor is triggered, the compressed air supply to the extraction well pumps will be shut off to prevent additional groundwater being pumped into the tank.

A different tank-level sensor will monitor for two additional level conditions, high and high-high. If a high level condition exists, a local display light within the building will activate. If a high-high level condition exists, the compressed air supply to the extraction well pumps will be shut off to prevent additional groundwater being pumped into the tank.

A leak-detection sensor will monitor the storage tank's secondary containment space. If liquid is detected, a local indicator light will activate; and the compressed air supply to the extraction well pumps will be shut off to prevent additional groundwater being pumped into the tank.

The tank's alarm status will be monitored to alert the selected O&M Contractor when the following conditions are realized: tank high-high level, liquid detected in storage tank's secondary containment space; and compressed air supply to extraction wells is not operational.

3.7.3.3 Groundwater Storage System

The existing on-site, aboveground storage tank will be replaced with a new, 5,000-gallon, double-walled aboveground storage tank. The new tank will be located within a new pre-engineered metal storage building, which will have a minimum footprint of about twenty (20) feet by twenty-four (24) feet. In addition, this building will be heated to prevent freezing of the holding tank and fill lines.

The tank will be equipped with an overflow protection device, a high-level sensor that will shut down the extraction well pumps, a local tank level gauge, an atmospheric vent, a pressure/vacuum relief vent, and emergency vents for the main tank and secondary containment. The secondary containment will be continuously monitored with a tank leak-detection system. A flow meter/totalizer will be installed inside the new building, located adjacent to the aboveground storage tank, to record pumping rates and total volumes pumped from the extraction wells.

The tank will be periodically evacuated using a tanker truck equipped with a vacuum pump. The stored groundwater will be transferred from the on-site storage tank to the tanker truck under continuous vacuum. The transfer line will be hard-piped from the storage tank to the building wall. The transfer line from the building to the tanker truck will be a flexible material handling hose equipped with cam and groove hose couplings.

See Figures 9 through 12 for additional details with respect to the proposed new groundwater recovery system and pre-engineered metal building. See Section 13120 of the Technical Specifications (see Appendix G) for additional information and design requirements with respect to the proposed new pre-engineered metal building.

3.7.4 Discharge, Treatment and Disposal

Currently, extracted groundwater is collected in an on-site, aboveground storage tank and periodically transported, via tanker truck, to the DuPont Environmental Treatment (DET) facility located in Deepwater, New Jersey.

The PDR stated that a discharge permit application would be submitted to the Bergen County POTW treatment facility to determine whether or not the extracted groundwater could be discharged to the POTW via a new sewer connection. Subsequent analysis of potential capital and yearly O&M costs associated with designing, purchasing, and installing a pre-treatment system to meet the Bergen County's POTW standards for accepting groundwater, indicated that this approach is not economical.

Based on this analysis, the extracted groundwater will continue to be conveyed to an on-site, aboveground storage tank, which will be periodically evacuated and the contents transported to a suitable off-site facility.

4.0 SEQUENCE OF CONSTRUCTION

Given the remedial action objectives for OU-2 presented in the August 26, ROD (see Section 1.3 herein), the overall sequence of construction will be critical to the successful execution and completion of the proposed OU-2 remedy.

In particular, the selected Remedial Contractor will be required to implement the proposed OU-2 Remedy subject to the following requirements:

- The integrity and stability of the existing slurry wall must be maintained and protected throughout the entire construction period;
- The existing shallow groundwater interceptor well system must remain operational for as long a time as possible, until such time that the proposed new groundwater recovery system is installed and made operational; and
- The proposed remedy must be conducted such that adverse impacts to and encroachment into Peach Island Creek are avoided.

The selected Remedial Contractor will ultimately be responsible for establishing its own “means-and-methods” and sequence-of-operations (including, but not limited to, staging the work, facilitating delivery of materials/equipment, and stockpiling materials on-site) to complete the proposed OU-2 remedy within the contract specified schedule.

One possible implementation scenario for the proposed OU-2 Remedial Action, such that the design objectives and the above-noted requirements are met, would involve the following general sequence of operations:

- a) Implement the proposed stream bank enhancements along Peach Island Creek. This would involve installing a new steel sheet pile wall five (5) feet behind the existing sheet pile walls, excavating the fill materials from between the new and existing sheet pile walls, and cutting/removing those portions of the existing sheet pile wall above the Peach Island Creek low water level;
- b) Perform the proposed In-Situ “Hot Spot” Treatment activities, including the required Field Verification Program;
- c) Install the proposed new groundwater recovery system, and associated pre-engineered metal building, leachate holding tank, and new groundwater observation piezometers;

-
- d) Once the proposed new groundwater recovery system is installed and made operational, remove the existing groundwater recovery system, and decommission the old interior wells and piezometers circumscribed by the perimeter soil-bentonite slurry wall.
 - e) Remove what remains of the existing geomembrane, and dispose of it off-site; and
 - f) Construct the proposed new vegetated cap system and surface water management features.

Some of the above construction operations may be implemented concurrently, subject to physical space limitations.

The Technical Specifications for the proposed OU-2 Remedy include requirements for the Remedial Contractor to manage, handle, and dispose of surface water and groundwater generated over the course of the entire construction period. As a result, the sequence for removing the existing geomembrane will be critical to the overall project schedule, because removal of this geomembrane would allow surface water to infiltrate into the fill, and this additional volume of infiltrate would have to be removed by the groundwater recovery system to maintain groundwater levels within the existing slurry wall.

5.0 CONTRACT DOCUMENTS

5.1 Construction Drawings

The anticipated construction drawings for the OU-2 Remedy include, but may not be limited to, the following:

Figure No.	Title
n/a	Cover Sheet
1	(Not Used)
2	(Not Used)
3	Site Plan
4	Grading and Drainage Plan
5	Grading and Drainage Details
6	Soil Erosion and Sediment Control Plan
7	Soil Erosion and Sediment Control Details
8	In-Situ "Hot Spot" Treatment Plan and Details
9	Groundwater Recovery System Plan
10	Groundwater Recovery System Details (1 of 2)
11	Groundwater Recovery System Details (2 of 2)
12	Groundwater Recovery System Process Flow Diagram and Equipment List
13	Sheet Pile Wall Plan and Section
14	Sheet Pile Wall Details
15	Demolition Plan
16	Well Decommissioning Plan
17	Fence Restoration Plan
18	Survey Control Plan

Full-sized (i.e., 24-inch-tall by 36-inch-wide) copies of the above noted figures will be provided upon request.

5.2 Technical Specifications

See Appendix G for copies of the Technical Specifications for the OU-2 Remedy.

6.0 CONSTRUCTION MONITORING

6.1 Field Oversight

The proposed OU-2 remedy construction activities will be subject to on-site engineering inspection and oversight, and those activities requiring construction quality control include, but are not limited to, the following:

- Implementation of stream bank enhancements;
- In-situ "Hot Spot" treatment technologies;
- Installation of the new shallow groundwater recovery system;
- Cap construction; and
- All associated excavation, backfill and compaction, groundwater control, and existing geomembrane removal activities.

These quality control services will be undertaken by qualified engineers and/or inspectors under the direct supervision of a Professional Engineer, licensed and registered in the State of New Jersey. See Appendix H for a copy of the project's Construction Quality Assurance Plan (CQAP).

6.2 Air Monitoring

As part of the Technical Specifications for the OU-2 Remedy, the Remedial Contractor will be required to prepare a Site-specific, comprehensive, detailed Health and Safety Plan (HASP), which will include, but not be limited to, performance of on-site air monitoring to ensure the health and safety of the on-site workers and potential off-site receptors.

See Section 01564 of the Technical Specifications for the OU-2 Remedy (see Appendix G) for additional information and details with respect to the health and safety requirements.

7.0 OPERATIONS AND MAINTENANCE

Following completion of construction activities for the OU-2 Remedy, the selected remedy will require Operation and Maintenance (O&M) activities to ensure the continued integrity of the remedy. Appendix I provides an annotated "Table of Contents" for the anticipated O&M plan for the OU-2 Remedy.

8.0 ACCESS AND DEED RESTRICTIONS

Institutional controls to restrict use of the property and otherwise ensure the continued effectiveness of the remedy will be implemented and maintained.

Construction of the proposed OU-2 Remedial Action will require the temporary removal and/or relocation of portions of the existing perimeter fence. In particular, the perimeter fence along Peach Island Creek will have to be removed to facilitate implementation of the proposed stream bank enhancements. Hence, the Contract Documents include provisions for the partial removal, replacement, and/or restoration of sections of the perimeter Site fence.

The Group has secured the necessary access easement from the current property owner (the Borough of Carlstadt) to implement the remedy; the easement also provides the Borough's approval to apply the required Deed Notice to the property upon completion of the remedy. The form of Deed Notice approved by USEPA and the Borough is included as Appendix F to the July 14, 2004 Consent Decree.

9.0 PERMIT EQUIVALENCIES

According to EPA policy, CERCLA response actions conducted on-site are exempted by law from the requirement to obtain Federal, State or local permits; however, said response actions are still required to meet the substantive provisions of permitting regulations that are considered Applicable or Relevant and Appropriate Requirements (ARARs). Therefore, under CERCLA, the remedial activities proposed in USEPA's ROD have been designed through the permit "equivalency" process to address the ARARs. The permit equivalency process is similar to the standard permitting process except that administrative requirements are waived, such as permit fees, public notice requirements, and landowner signatures.

Golder contracted ASGECI to assist with permit equivalency requirements for the OU-2 work. Through several communications between ASGECI and representatives in the Division of Land Use at the New Jersey Environmental Protection (NJDEP), including conversations with Dennis Contois of NJDEP Division of Land Use Regulation (DLUR) on March 28 & 30, and April 17, 2007 and Diane Dow of NJDEP DLUR on March 29, 2007, it was determined that no Waterfront Development Permit equivalency would be required for the project since the proposed activities would be landward of the mean high water level.

It was further determined that a Minor Stream Encroachment Permit (SEP) equivalency would be required for the project, for activities adjacent to Peach Island Creek, in accordance with the NJ Flood Hazard Area Control Act. As Peach Island Creek is a tidally influenced body of water, only the environmental standards are required to be addressed in the permit equivalency. Appendix J includes all documentation necessary to meet the minor SEP equivalency requirements.

Authorization from the US Army Corps of Engineers, New York City District, is not required for the project. No activities are proposed in waters of the US. Furthermore, activities undertaken entirely on a CERCLA site by authority of CERCLA as required by USEPA, are not required to obtain permits under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act.

The Remedial Contractor will also be required by the In-Situ "Hot Spot" Treatment Technical Specification (Section 02450 of Technical Specifications) to prepare, submit, and obtain all air emissions and pollution control permits and/or certificates, as necessary and required by any Federal, State, local rules, regulations, laws, and/or statutes.

In addition, the Technical Specifications for the OU-2 Remedy include provisions requiring the Remedial Contractor to prepare, submit, and obtain a Soil Erosion and Sediment Control Permit and/or Certification from the Bergen County, New Jersey Soil Conservation Service.

10.0 SCHEDULE

Submission of this FDR complies with the schedule presented in the approved RDWP (Golder, 2005). Upon Agency approval of the FDR, the Group will complete the Contractor Procurement activities.

Figure 19 provides an updated remedial design and remedial action schedule for the OU-2 Remedy. Selection of a remedial action contractor will be completed in accordance with the schedule and will involve the following steps:

- Contractor prequalifications;
- Construction bid package preparation;
- Construction bid solicitation; and,
- Award of construction contract.

A list of prequalified firms that possess the expertise and experience necessary to complete the Work will be developed based on Statement of Qualifications (SOQ) requested from potentially qualified firms. The technical components of the approved Final Design Report and CQA plan will be integrated with bidding requirements and general contract administrative provisions to produce construction bid packages. The bid package will include an Invitation to Bid, Instructions to Bidders, the Construction Agreement, General Contract Provisions, and Technical Provisions. Bids for the remedial construction work will be solicited by issuance of the final bid package(s) to the prequalified remediation contractors. The 216 Paterson Plank Road PRP Group will select the remedial action contractor based on review of the bids received.

11.0 REFERENCES

- Canonie Environmental, 1992. "Final Report Interim Remedy for First Operable Unit Scientific Chemical Processing Superfund Site at 216 Paterson Plank Road, Carlstadt, New Jersey," September 1992.
- Canonie Environmental, 1991. "Interim Remedy Remedial Design Report," July 19, 1991.
- Canonie Environmental, 1991. "Operations and Maintenance Plan"
- Dames and Moore, 1990. "Final Report - Remedial Investigation SCP Site, Carlstadt, New Jersey," March 1, 1990.
- Dames and Moore, 1989. "Test Pit Investigation SCP/Carlstadt July 1989," August 4, 1989.
- Dames and Moore, 1988. "Revision No. 9, Project Operations Plan, SCP Site Remedial Investigation, Carlstadt, New Jersey," September 30, 1988.
- Dames & Moore, 1988. "Revision No. 8 (Amended) Project Operations Plan, SCP Site Remedial Investigation, Carlstadt, New Jersey," September 30, 1988.
- Environmental Resources Management, Inc., 1989. "Preliminary Feasibility Study for the First Operable Unit of the SCP/Carlstadt Site," July 1989.
- Golder Associates Inc., 2005. "Revised Remedial Design Work Plan for Operable Unit 2", April 2005.
- Golder Associates Inc., 2001. "Focused Feasibility Study Operable Unit 2 Final Remedy: Fill and Shallow Groundwater", April 2001.
- Golder Associates Inc., 1997. "Focused Feasibility Investigation Report", November 1997.
- Golder Associates Inc., 2005. "Preliminary (35% Design) Remedial Design Report", December 2005.
- Kiber Environmental Services, Inc. "216 Patterson Plank Road Site – Treatability Study – Final Report", July 2000.

**FINAL DESIGN REPORT
OPERABLE UNIT 2 (OU-2)
216 PATERSON PLANK ROAD SITE**

**TABLE 1
Geotechnical Design Parameters**

Material/Strata	Index Properties			Consolidation Parameters				Strength Parameters			
				e _o	Compression Indices			C _v	f	c	S _u
	g _{sat}	w _o	PI		C _c	C _a	C _a /C _c				
Imported Fill Materials:											
Common, Grading Fill	120								33	0	
Structural Fill	120								33	0	
Subsurface Deposits:											
Fill	120								33	0	
Meadow Mat/Peat	80	300		9.0	6.00	0.36	0.06	1.00	0		100
Organic Silt/Clay	110	120	40	2.0	0.90	0.05	0.05	0.20	0		200
Upper Varved Clay	120	30	20	0.8	0.40	0.02	0.04	0.20	0		600
Lower Varved Clay	115	50	30	1.1	0.60	0.02	0.04	0.30	0		400
Glacial Till	120	10	5						28	200	

Legend: g_{sat} = Unit Weight, lbs/ft³ (psf)
 w_o = Natural Water Content, %
 PI = Plasticity Index
 e_o = Initial Void Ratio
 f = Internal Friction Angle, degrees
 c = Cohesion, lbs/ft² (psf)
 S_u = Existing Mobilized Undrained Shear Strength, lbs/ft² (psf)
 C_c = Compressibility Index
 C_a = Secondary Compression Index
 C_v = Coefficient of Consolidation, ft²/day

Notes:

- Design values shown herein are based on laboratory testing data, published literature, experiences with similar materials, generally accepted industry standards, and professional geotechnical engineering judgment.
- C_a and C_v values vary with load, and values shown herein typically correspond to a load increment of 2 tsf.

**FINAL DESIGN REPORT
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216 PATERSON PLANK ROAD SITE**

**TABLE 2
FFSi Report Nov. 1997
Sampling and Analyses Summary**

SAMPLE POINT ID	SAMPLE DEPTH (FT.)	SAMPLE MEDIA	SAMPLING DATE	ANALYTICAL PARAMETER (1)	QA/QC (2)	
					FIELD DUPLICATE	MS/MSD
B-1B	2-4 (VOC-3.5-4.0)	SILTY CLAY/CLAY (FILL)	8/6/1997	TCL/TAL, pH, moisture content, grain size analysis, TOC, and oil & grease		B-1B
GBR-02B	2-4 (VOC-3.5-4.0)	SLUDGE	8/18/1997	TCL/TAL, pH, moisture content, grain size analysis, TOC, and oil & grease		
GBR-02C	4-5.2 (VOC-4.7-5.2)	SLUDGE	8/18/1997	TCL/TAL, pH, moisture content, grain size analysis, TOC, and oil & grease		
GB-04B	2-4 (VOC-3-3.5)	SILTY CLAY (FILL)	8/11/1997	TCL/TAL, pH, moisture content, grain size analysis, TOC, and oil & grease		GB-04B
GB-04D	6-8 (VOC-6.5-7.0)	SLUDGE	8/11/1997	TCL/TAL, pH, moisture content, grain size analysis, TOC, and oil & grease	FGB-04D	
GB-06D	6-8 (VOC-7.2-7.7)	SLUDGE/SOIL (FILL)	8/11/1997	TCL/TAL, pH, moisture content, grain size analysis, TOC, and oil & grease		
GB-07F	10-12 (VOC-10.8-11.3)	SLUDGE/SOIL (FILL)	8/12/1997	TCL/TAL, pH, moisture content, grain size analysis, TOC, and oil & grease		
GB-14C	4-5.7 (VOC-5.2-5.7)	SLUDGE	8/15/1997	TCL/TAL, pH, moisture content, grain size analysis, TOC, and oil & grease		
GEOTECHNICAL (3)						
ST-03 (GB-02)	8.5-11.0	PEAT	8/7/1997	Unconsolidated undrained triaxial compression with pore water pressure measurement & grain size analysis		
ST-04 (GB-02)	12.5-15.0	SILTY CLAY	8/7/1997	Unconsolidated undrained triaxial compression with pore water pressure measurement & grain size analysis		
ST-05 (GB-01)	8.5-11.0	SILT	8/8/1997	Unconsolidated undrained triaxial compression with pore water pressure measurement & grain size analysis		

Notes:

- (1) - TCL VOCs, SVOCs, and Pest/PCBs Methodology: CLP SOW OLMO3.2 (CompuChem OLMO3.1); TAL Metals Methodology: CLP SOW ILMO3.0 (CompuChem ILMO4.0); Oil & Grease Methodology: SW846-9070/EPA 413.2, Total Organic Carbon Methodology: EPA Lloyd Khan Method, pH Methodology: LaMotte; Moisture Content Methodology: ASTM D2216; Grain Size Analysis Methodology: ASTM D-412/422 & D-1140; and, unconsolidated undrained triaxial compression with pore water pressure measurement Methodology: ASTM D-2850
- (2) - Equipment Rinsate Blanks were taken one per day of sampling.
- (3) - A total of seven Shelby tube samples were collected of which three samples, based on recovery, were submitted for analysis.

**FINAL DESIGN REPORT
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216 PATERSON PLANK ROAD SITE**

**TABLE 3A
FFSI Report Nov. 1997
Summary of Chemistry Analysis Detections
Soil/Fill Samples
Organic Detections - Volatiles**

EPA INITIAL PRGs (1) (mg/kg)	PARAMETER						
		B-1B Sampled: 8/6/97 RESULT (mg/kg)	GBR-02B Sampled: 8/18/97 RESULT (mg/kg)	GBR-02C Sampled: 8/18/97 RESULT (mg/kg)	GB-4B Sampled: 8/11/97 RESULT (mg/kg)	GB-4D Sampled: 8/11/97 RESULT (mg/kg)	FGB-4D (Dup.) Sampled: 8/11/97 RESULT (mg/kg)
198	Benzene	-	28	38	34	73	66
1,220,000	2-Butanone	-	-	-	-	260	-
40,000	Chlorobenzene	8.4	86	74	380	1,200	1,000
940	Chloroform	-	-	-	54	30	31
200,000	1,1-Dichloroethane	3.4	-	-	51	210	160
—	Total 1,2-Dichloroethene	4.2	-	-	30	24	-
62	1,2-Dichloroethane	-	-	-	-	-	-
200,000	Ethylbenzene	110	420	350	940	1,100	970
760	Methylene Chloride	-	38	38	52	100	100
—	4-Methyl-2-Pentanone	19	-	97	190	460	420
184,000	1,1,1-Trichloroethane	-	-	-	430	150	150
110	Tetrachloroethene	330	1,200	880	5,200	8,200	4,800
400,000	Toluene	470	2,200	1,800	4,700	5,900	4,500
520	Trichloroethene	520	2,400	1,600	6,000	6,700	5,500
3	Vinyl chloride	-	-	58	-	-	-
4,000,000	Total Xylenes	720	2,600	2,100	5,300	5,700	5,200

Notes:

Units are in mg/kg.

(1) - EPA initial Preliminary Remediation Goals (PRGs) taken from a letter dated November 19, 1993 from EPA to Langan Environmental Services.

All results reported on a wet weight basis.

"—" indicates that no initial PRG is available.

Indicates exceedance of the EPA initial PRG.

"-" indicates that the constituent was not detected as qualified with a "U" or "UU".

**FINAL DESIGN REPORT
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216 PATERSON PLANK ROAD SITE**

**TABLE 3A
FFSI Report Nov. 1997
Summary of Chemistry Analysis Detections
Soil/Fill Samples
Organic Detections - Volatiles**

EPA INITIAL PRGs (1) (mg/kg)	PARAMETER	GB-6D	GB-7F	GB-14C
		Sampled: 8/11/97 RESULT (mg/kg)	Sampled: 8/12/97 RESULT (mg/kg)	Sampled: 8/15/97 RESULT (mg/kg)
198	Benzene	57	62	28
1,220,000	2-Butanone	340	370	57
40,000	Chlorobenzene	260	260	49
940	Chloroform	240	340	-
200,000	1,1-Dichloroethane	120	-	16
—	Total 1,2-Dichloroethene	49	28	-
62	1,2-Dichloroethane	-	340	-
200,000	Ethylbenzene	1,100	1,100	100
760	Methylene Chloride	200	450	-
—	4-Methyl-2-Pentanone	440	470	42
184,000	1,1,1-Trichloroethane	1,200	2,700	-
110	Tetrachloroethene	6,000	8,900	370
400,000	Toluene	5,700	6,700	410
520	Trichloroethene	7,300	8,900	99
3	Vinyl chloride	-	-	44
4,000,000	Total Xylenes	6,100	5,700	550

Notes:

Units are in mg/kg.

(1) - EPA Initial Preliminary Remediation Goals (PRGs) taken from a letter dated November 19, 1993 from EPA to Langan Environmental Services.

All results reported on a wet weight basis.

"—" indicates that no initial PRG is available.

Indicates exceedance of the EPA initial PRG.

"-" indicates that the constituent was not detected as qualified with a "U" or "UJ".

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**TABLE 3B
FFSI Report Nov. 1997
Summary of Chemical Analysis Detections
Sludge/Fill Samples
Organic Detections - Semivolatiles**

EPA INITIAL PRGs (1) (mg/kg)	PARAMETER	B-1B Sampled: 8/6/97 RESULT (mg/kg)	GBR-02B Sampled: 8/18/97 RESULT (mg/kg)	GBR-02C Sampled: 8/18/97 RESULT (mg/kg)	GB-4B Sampled: 8/11/97 RESULT (mg/kg)	GB-4D Sampled: 8/11/97 RESULT (mg/kg)	FGB-4D (Dup.) Sampled: 8/11/97 RESULT (mg/kg)
		RESULT (mg/kg)	RESULT (mg/kg)	RESULT (mg/kg)	RESULT (mg/kg)	RESULT (mg/kg)	RESULT (mg/kg)
50,000	Phenol	1.7	56	72	48	64	70
184,000	1,2-Dichlorobenzene	0.6	14	8.4	34	28	19
—	1,4-Dichlorobenzene	0.33	-	-	-	-	-
—	2-Methylphenol	-	3.5	3.3	-	-	-
—	4-Methylphenol	0.46	13	15	18	15	16
1,020	Nitrobenzene	-	-	-	-	-	-
6,000	Isophorone	1.4	50	13	-	14	8.7
40,000	2,4-Dimethylphenol	-	12	11	9.9	-	9
20,000	1,2,4-Trichlorobenzene	0.081	2.3	0.95	3.3	3	2
82,000	Napthalene	1.1	51	18	75	52	30
—	2-Methylnapthalene	0.51	21	6.5	25	18	12
—	2-Chloronapthalene	-	55	40	31	22	16
2,000,000	Dimethylphthalate	-	-	-	2.4	-	-
122,000	Acenaphthene	-	1.6	-	0.89	-	-
—	Dibenzofuran	0.16	5.4	2.1	2.6	3.2	2
1,640,000	Diethylphthalate	-	-	-	12	1.2	1.5
82,000	Fluorene	0.077	3.2	0.89	1.2	1.6	1.2
—	Phenanthrene	0.24	12	4.3	4.1	4.2	2.8
620,000	Anthracene	-	1.8	-	-	-	-
—	Carbazole	-	0.92	-	-	-	-
—	Di-n-butylphthalate	0.37	-	-	52	8.7	9.1
82,000	Fluoranthene	-	6.9	1.8	2.5	2	1.3
62,000	Pyrene	-	4.6	1.1	1.6	1.8	0.98
400,000	Butylbenzylphthalate	0.043	-	-	20	2.2	2.9
7.8	Benzo(a)anthracene	-	2.4	0.55	0.9	0.59	0.47
78,000	Chrysene	-	3	0.72	1.1	1.1	0.81
400	Bis(2-ethylhexyl)phthalate	7.3	37	8.5	500	190	110
40,000	Di-n-octylphthalate	0.5	-	-	23	4.5	4.7
7.8	Benzo(b)fluoranthene	0.069	2.3	-	0.82	0.7	-
78	Benzo(k)fluoranthene	0.068	1.6	-	0.62	0.49	-
0.78	Benzo(a)pyrene	-	1.2	-	-	-	-
7.8	Indeno(1,2,3-cd)pyrene	-	1.3	-	-	-	-
0.78	Dibenz(a,h)anthracene	-	1.1	-	-	-	-
—	Benzo(g,h,i)perylene	-	1.4	-	0.6	-	-

Notes:

Units are in mg/kg.

(1) - EPA Initial Preliminary Remediation Goals (PRGs) taken from a letter dated November 19, 1993 from EPA to Langan Environmental Services.

All results reported on a wet weight basis.

"—" indicates that no initial PRG is available.

"X" indicates exceedance of the EPA initial PRG.

"—" indicates that the constituent was not detected as qualified with a "U", "UJ" or "R".

**FINAL DESIGN REPORT
OPERABLE UNIT 2 (OU-2)
216 PATERSON PLANK ROAD SITE**

**TABLE 3B
FFSI Report Nov. 1997
Summary of Chemical Analysis Detections
Sludge/Fill Samples
Organic Detections - Semivolatiles**

EPA INITIAL PRGs (1) (mg/kg)	PARAMETER	GB-6D	GB-7F	GB-14C
		Sampled: 8/11/97 RESULT (mg/kg)	Sampled: 8/12/97 RESULT (mg/kg)	Sampled: 8/15/97 RESULT (mg/kg)
50,000	Phenol	140	95	25
184,000	1,2-Dichlorobenzene	57	130	3.4
—	1,4-Dichlorobenzene	-	-	-
—	2-Methylphenol	-	-	-
—	4-Methylphenol	24	20	5.6
1,020	Nitrobenzene	-	380	-
6,000	Isophorone	33	20	1.1
40,000	2,4-Dimethylphenol	19	10	4.7
20,000	1,2,4-Trichlorobenzene	5.7	-	-
82,000	Napthalene	73	57	3
—	2-Methylnapthalene	28	21	1.1
—	2-Chloronapthalene	97	35	23
2,000,000	Dimethylphthalate	-	-	-
122,000	Acenaphthene	-	-	-
—	Dibenzofuran	3.9	-	-
1,640,000	Diethylphthalate	4.2	13	-
82,000	Fluorene	2	-	-
—	Phenanthrene	6.3	5.5	-
620,000	Anthracene	-	-	-
—	Carbazole	-	-	-
—	Di-n-butylphthalate	42	56	-
82,000	Fluoranthene	3.7	-	-
62,000	Pyrene	3.6	-	-
400,000	Butylbenzylphthalate	19	37	-
7.8	Benzo(a)anthracene	1.7	-	-
78,000	Chrysene	2	-	-
400	Bis(2-ethylhexyl)phthalate	610	430	1.3
40,000	Di-n-octylphthalate	37	17	-
7.8	Benzo(b)fluoranthene	-	-	-
78	Benzo(k)fluoranthene	-	-	-
0.78	Benzo(a)pyrene	0.55	-	-
7.8	Indeno(1,2,3-cd)pyrene	0.79	-	-
0.78	Dibenz(a,h)anthracene	-	-	-
—	Benzo(g,h,i)perylene	1.2	-	-

Notes:

Units are in mg/kg.

(1) -EPA Initial Preliminary Remediation Goals (PRGs) taken from a letter dated November 19, 1993 from EPA to Langan Environmental Services.

All results reported on a wet weight basis.

"—" indicates that no initial PRG is available.

Indicates exceedance of the EPA initial PRG.

"-" indicates that the constituent was not detected as qualified with a "U", "UJ" or "R".

**FINAL DESIGN REPORT
OPERABLE UNIT 2 (OU-2)
216 PATERSON PLANK ROAD SITE**

**TABLE 3C
FFSI Report Nov. 1997
Sum. of Chemical Analysis Detections
Sludge/Fill Samp.
Pesticide/PCB Detections**

EPA INITIAL PRGs (1) (mg/kg)	PARAMETER	B-1B Sampled: 8/6/97	GBR-02B Sampled: 8/18/97	GBR-02C Sampled: 8/18/97	GB-4B Sampled: 8/11/97	GB-4D Sampled: 8/11/97	FGB-4D (Dup.) Sampled: 8/11/97
		RESULT (mg/kg)	RESULT (mg/kg)	RESULT (mg/kg)	RESULT (mg/kg)	RESULT (mg/kg)	RESULT (mg/kg)
—	Endrine Ketone	-	-	-	-	-	12
0.34	Aldrin	1.6	-	-	-	-	-
0.36	Dieldrin	0.86	-	-	-	-	-
10-25	Aroclor-1242	49	390	300	770	800	680

Notes:

Units are in mg/kg.

(1) - EPA Initial Preliminary Remediation Goals (PRGs) taken from a letter dated November 19, 1993 from EPA to Langan Environmental Services.

All results reported on a wet weight basis.

"—" indicates that no initial PRG is available.

Indicates exceedance of the EPA initial PRG.

"-" indicates that the constituent was not detected as qualified with a "U", "UJ" or "R".

**FINAL DESIGN REPORT
OPERABLE UNIT 2 (OU-2)
216 PATERSON PLANK ROAD SITE**

**TABLE 3C
FFSI Report Nov. 1997
Sum. of Chemical Analysis Detections
Sludge/Fill Samp.
Pesticide/PCB Detections**

EPA INITIAL PRGs (1) (mg/kg)	PARAMETER			
		GB-6D	GB-7F	GB-14C
		Sampled:8/11/97 RESULT (mg/kg)	Sampled:8/12/97 RESULT (mg/kg)	Sampled:8/15/97 RESULT (mg/kg)
—	Endrine Ketone	-	-	-
0.34	Aldrin	-	-	-
0.36	Dieldrin	-	-	-
10-25	Aroclor-1242	1,400	1,300	82

Notes:

Units are in mg/kg.

(1) - EPA Initial Preliminary Remediation Goals (PRGs) taken from a letter dated November 19, 1993 from EPA to Langan Environmental Services.

All results reported on a wet weight basis.

"—" indicates that no initial PRG is available.

 Indicates exceedance of the EPA initial PRG.

"- " indicates that the constituent was not detected as qualified with a "U", "UJ" or "R".

**FINAL DESIGN REPORT
OPERABLE UNIT 2 (OU-2)
216 PATERSON PLANK ROAD SITE**

**TABLE 3D
FFSI Report Nov. 1997
Summary of Chemistry Analysis Detections
Sludge/Fill Samples
Inorganic Detections**

EPA INITIAL PRGs (1) (mg/kg)	PARAMETER	B-1B Sampled: 8/6/97	GBR-02B Sampled: 8/18/97	GBR-02C Sampled: 8/18/97	GB-4B Sampled: 8/11/97	GB-4D Sampled: 8/11/97	FGB-4D (Dup.) Sampled: 8/11/97
		RESULT (mg/kg)	RESULT (mg/kg)	RESULT (mg/kg)	RESULT (mg/kg)	RESULT (mg/kg)	RESULT (mg/kg)
—	Aluminum	5,140	5,040	3,090	4,270	3,890	3,800
820	Antimony	1.4	1.3	2.7	10.1	8.1	7.4
3.2	Arsenic	11.2	4.0	6.1	12.7	9.3	7.8
—	Barium	349	91.6	119	590	637	653
1.34	Beryllium	0.41	0.56	0.86	1.80	1.30	1.30
1,020	Cadmium	147	6.4	10	43.4	52	39
—	Calcium	19,200	18,800	37,300	23,900	37,400	36,700
10,200 (VI)	Chromium	58	91.9	203	209	265	255
—	Cobalt	2.9	2.7	1.9	5.6	4.7	4.2
76,000	Copper	5,760	975	2,590	6,350	4,180	4,250
—	Iron	9,830	6,140	4,920	13,600	11,400	10,000
500-1,000	Lead	245	228	479	947	909	985
—	Magnesium	2,780	1,340	5,280	2,260	3,280	3,240
—	Manganese	124	80.7	123	189	181	168
620	Mercury	2.2	7.5	2.9	4.7	4.4	3.7
40,000	Nickel	10.5	9.9	12.8	16.7	19.9	18.9
—	Potassium	395	625	480	507	537	529
10,200	Selenium	3.8	-	1.1	1.7	2.2	2.0
10,200	Silver	0.53	2.8	4.9	1.4	6.9	7.2
—	Sodium	6,550	35,800	44,500	10,100	28,000	28,200
144	Thallium	-	-	-	-	-	-
—	Vanadium	12.3	12.9	12.3	19.2	17.5	16.7
620,000	Zinc	242	268	365	1,840	2,260	2,500

Notes:

Units are in mg/kg.

(1) - EPA Initial Preliminary Remediation Goals (PRGs) taken from a letter dated November 19, 1993 from EPA to Langan Environmental Services.

All results reported on a wet weight basis.

"—" indicates that no initial PRG is available.

[Shaded] indicates exceedance of the EPA initial PRG.

"U" indicates that the constituent was not detected as qualified with a "U" or "UU".

**FINAL DESIGN REPORT
OPERABLE UNIT 2 (OU-2)
216 PATERSON PLANK ROAD SITE**

**TABLE 3D
FFSI Report Nov. 1997
Summary of Chemistry Analysis Detections
Sludge/Fill Samples
Inorganic Detections**

EPA INITIAL PRGs (1) (mg/kg)	PARAMETER	GB-6D	GB-7F	GB-14C
		Sampled: 8/11/97 RESULT (mg/kg)	Sampled: 8/12/97 RESULT (mg/kg)	Sampled: 8/15/97 RESULT (mg/kg)
—	Aluminum	4,830	2,660	3,990
820	Antimony	6.0	12.8	1.2
3.2	Arsenic	10.8	9.3	5.1
—	Barium	619	702	68.3
1.34	Beryllium	1.0	0.72	2.50
1,020	Cadmium	34.1	47.4	6.7
—	Calcium	25,600	19,800	21,900
10,200 (VI)	Chromium	260	233	71.5
—	Cobalt	4.4	4.5	1.4
76,000	Copper	2,970	1,830	10,200
—	Iron	12,000	22,700	3,370
500-1,000	Lead	813	1,320	152
—	Magnesium	2,550	1,420	5,260
—	Manganese	198	153	81.1
620	Mercury	6.2	3.1	0.79
40,000	Nickel	14.8	12.4	7.6
—	Potassium	496	300	443
10,200	Selenium	1.1	2.0	-
10,200	Silver	1.4	1.8	0.6
—	Sodium	13,900	8,540	35,500
144	Thallium	-	-	-
—	Vanadium	18.9	19.3	6.7
620,000	Zinc	2,980	10,000	218

Notes:

Units are in mg/kg.

(1) -EPA Initial Preliminary Remediation Goals (PRGs) taken from a letter dated November 19, 1993 from EPA to Langan Environmental Services. All results reported on a wet weight basis.

"—" Indicates that no initial PRG is available.

"X" Indicates exceedance of the EPA initial PRG.

"—" indicates that the constituent was not detected as qualified with a "U" or "UU".

**FINAL DESIGN REPORT
OPERABLE UNIT 2 (OU-2)
216 PATERSON PLANK ROAD SITE**

**TABLE 3E
Summary of Chemistry Analysis Detections
Sludge/Fill Samples
Additional Parameter Detections**

INITIAL EPA PRGs (1) (mg/kg)	PARAMETER						
		B-1B Sampled: 8/6/97	GBR-02B Sampled: 8/18/97	GBR-02C Sampled: 8/18/97	GB-4B Sampled: 8/11/97	GB-4D Sampled: 8/11/97	FGB-4D (Dup.) Sampled: 8/11/97
		RESULT (mg/kg)	RESULT (mg/kg)	RESULT (mg/kg)	RESULT (mg/kg)	RESULT (mg/kg)	RESULT (mg/kg)
—	Oil and Grease, Gravimetric	(2)	19000	42000	50900	44800	41300
—	Oil and Grease, Infrared	18700	27000	28300	83700	21900	17800
—	TOC	16000	31700	36600	53500	61500	52600

Notes:

Units are in mg/kg.

(1) - Initial EPA Preliminary Remediation Goals (PRGs) taken from a letter dated November 19, 1993 from EPA to Langan Environmental Services.

(2) - Analysis not performed.

All results reported on a wet weight basis (sludge) except for sample B-1B.

"—" indicates that no initial PRG is available.

 indicates exceedance of the initial EPA PRG.

"-." indicates that the constituent was not detected as qualified with a "U" or "UJ".

**FINAL DESIGN REPORT
OPERABLE UNIT 2 (OU-2)
216 PATERSON PLANK ROAD SITE**

**TABLE 3E
Summary of Chemistry Analysis Detections
Sludge/Fill Samples
Additional Parameter Detections**

INITIAL EPA PRGs (1) (mg/kg)	PARAMETER			
		GB-6D	GB-7F	GB-14C
		Sampled: 8/11/97 RESULT (mg/kg)	Sampled: 8/12/97 RESULT (mg/kg)	Sampled: 8/15/97 RESULT (mg/kg)
—	Oil and Grease, Gravimetric	57200	106000	76900
—	Oil and Grease, Infrared	38400	47800	3040
—	TOC	62900	30600	30800

Notes:

Units are in mg/kg.

(1) - Initial EPA Preliminary Remediation Goals (PRGs) taken from a letter dated November 19, 1993 from EPA to Langan Environmental Services.

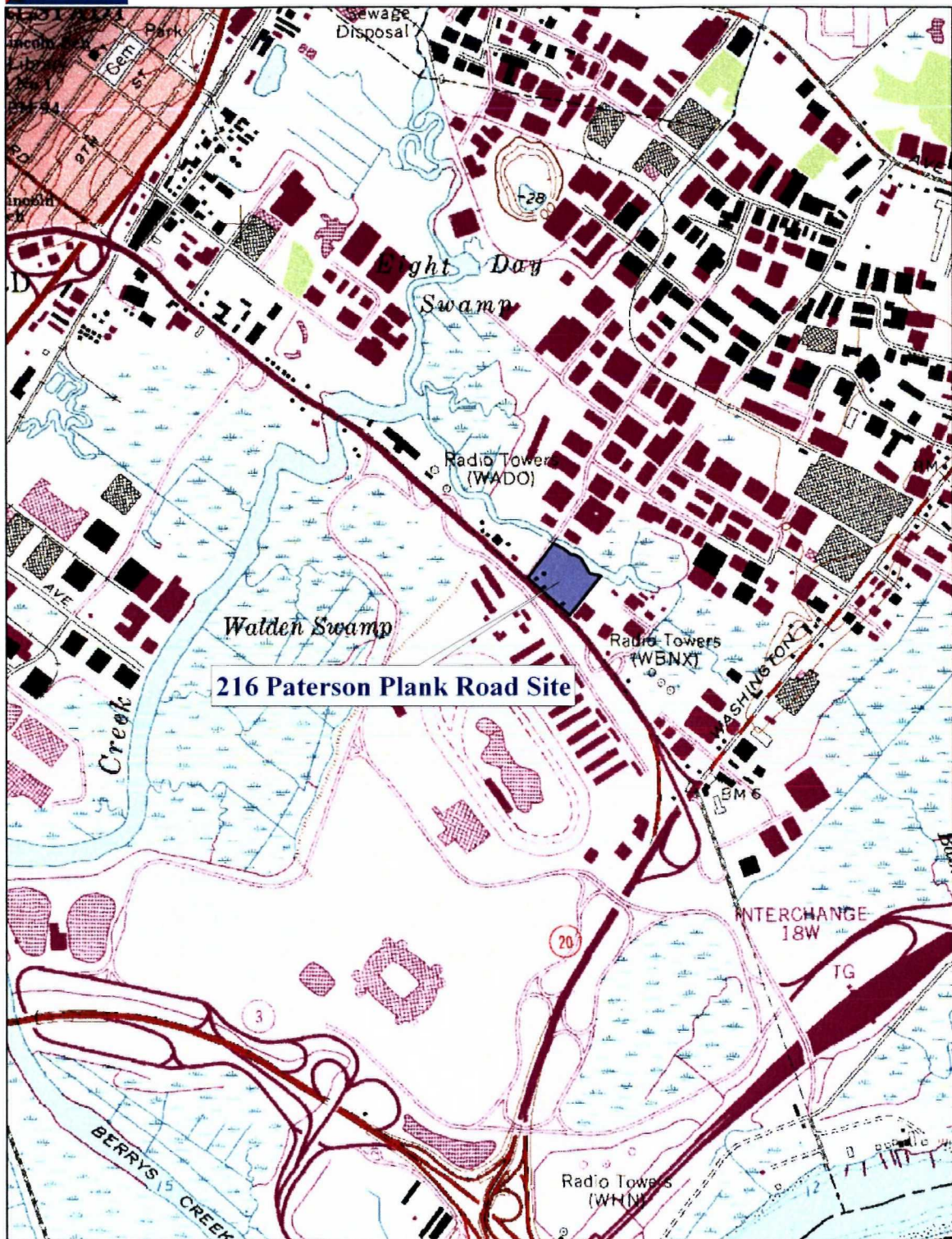
(2) - Analysis not performed.

All results reported on a wet weight basis (sludge) except for sample B-1B.

"—" indicates that no initial PRG is available.

 indicates exceedance of the initial EPA PRG.

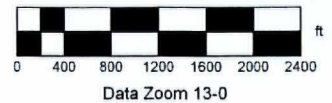
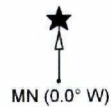
"-." indicates that the constituent was not detected as qualified with a "U" or "UJ".



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SCALE	AS SHOWN
DATE	05/04/2007
DESIGN	AB
CADD	AB
CHECK	RJI
REVIEW	MFM

TITLE

SITE LOCATION MAP

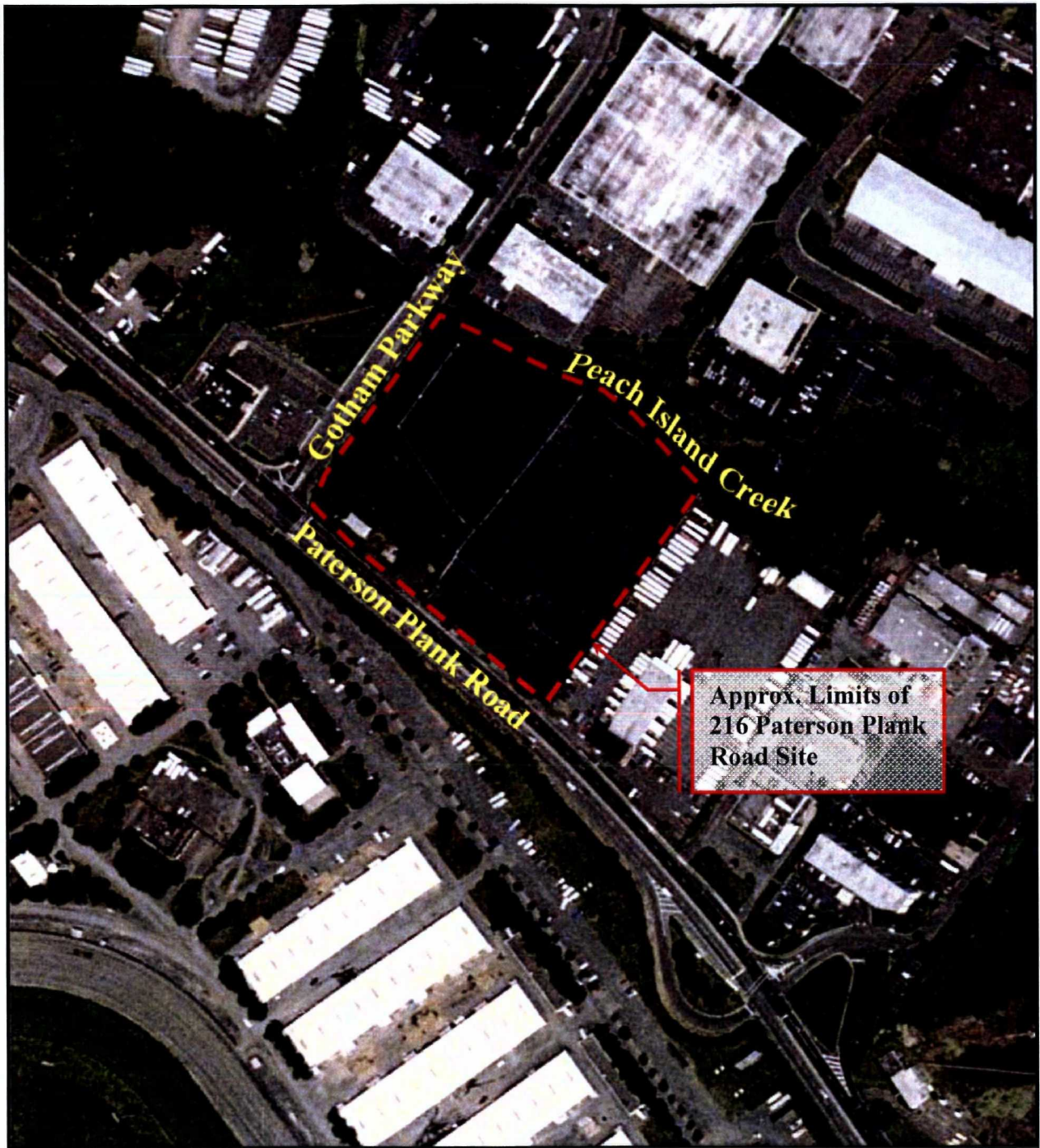
FILE No.: FDR - Fig 1

PROJECT No.: 943-6222 REV. 0

216 PATERSON PLANK ROAD SITE

FIGURE

1



Reference: Image acquired from www.terraserver.com.
 Image provider AirPhotoUSA, Inc.
 Image taken June 1, 2004.



SCALE	N.T.S.
DATE	05/04/2007
DESIGN	AB
CADD	AB
CHECK	RJI
REVIEW	MFM

TITLE

AERIAL SITE MAP

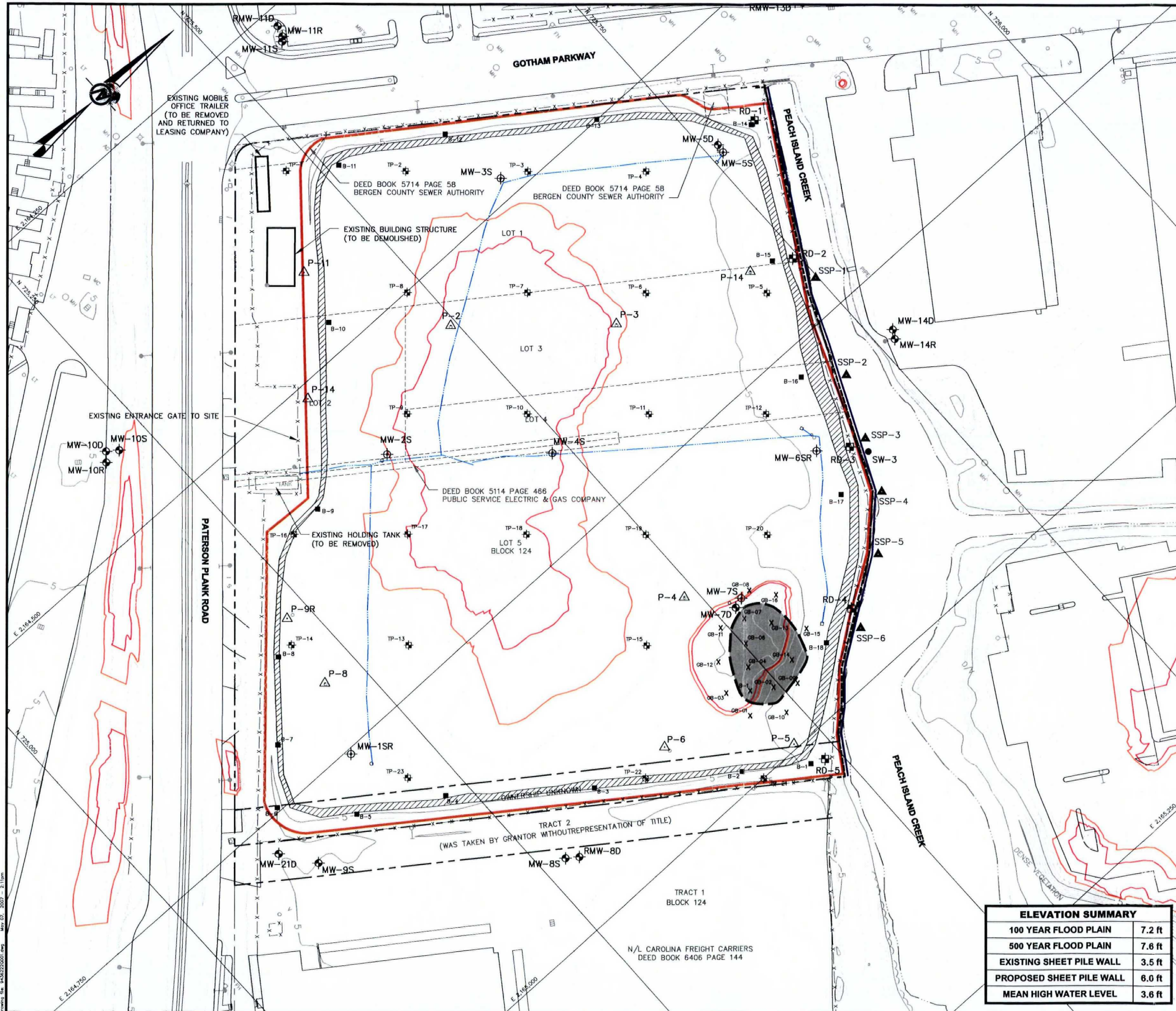
FILE No.: FDR – Fig 2

PROJECT No.: 943-6222 REV. 0

216 PATTERSON PLANK ROAD SITE

FIGURE

2



LEGEND

EXISTING GROUND CONTOUR

EDGE OF STREAM

EXISTING FENCE

PROPERTY LINE

EXISTING SLURRY WALL

EXISTING SHEET PILE WALL (TO BE PARTIALLY REMOVED)

EXISTING GROUNDWATER EXTRACTION SYSTEM DISCHARGE HEADERS (TO BE REMOVED)

LIMITS OF EXISTING GEOMEMBRANE (TO BE REMOVED)

100 YEAR FLOODPLAIN LEVEL (EL. = 7.2 ft.)

500 YEAR FLOODPLAIN LEVEL (EL. = 7.6 ft.)

MEAN HIGH WATER LEVEL (EL. = 3.6 ft.)

SW-3
EXISTING SURFACE WATER SAMPLING LOCATIONS (SEE NOTE 1)

MW-4S
EXISTING GROUNDWATER EXTRACTION WELLS

MW-5D
EXISTING GROUNDWATER MONITORING WELLS

P-4
EXISTING PIEZOMETERS

RD-1
PRE-DESIGN INVESTIGATION BORINGS

GB-06
SOIL BORING LOCATIONS (COMPLETED AS PART OF THE FSSI)

B-3
SLURRY WALL CONSTRUCTION INVESTIGATION BORINGS (DRILLED AS PART OF THE OU-1 INTERIM REMEDY)

TP-11
TEST PITS (EXCAVATED AS PART OF THE RI)

SSP-4
SEDIMENT SURVEY POINTS

LIMITS OF SLUDGE "HOT SPOT" AREA (SEE REFERENCE 2)

NOTES

1.) SURFACE WATER SAMPLING POINT SW-1 IS LOCATED AT THE CONFLUENCE OF PEACH ISLAND AND BERRY'S CREEKS, APPROXIMATELY ONE THIRD OF A MILE NORTHWEST OF THE SITE. SURFACE WATER SAMPLING POINT SW-2 IS LOCATED ON PEACH ISLAND CREEK, 150 FEET NORTHWEST OF THE SITE AS MEASURED FROM THE NORTH CORNER OF THE PROPERTY BOUNDARY. SURFACE WATER SAMPLING POINT SW-4 IS LOCATED ON PEACH ISLAND CREEK, 150 FEET EAST OF THE SITE, AS MEASURED FROM THE EAST CORNER OF THE PROPERTY BOUNDARY.

2.) ALL LOCATIONS ARE APPROXIMATE.

3.) MONITORING WELLS MW-10S, 10D AND 10R HAVE BEEN DECOMMISSIONED TO ACCOMMODATE CONSTRUCTION ON THE MEADOWLANDS SPORTS COMPLEX PROPERTY, AND WILL BE REINSTALLED AT A LATER DATE.

4.) SEE FIGURES 15 AND 16 FOR DEMOLITION AND WELL DECOMMISSIONING PLANS, RESPECTIVELY.

5.) THE EXISTING SHEET PILE WALL WAS INSTALLED WITH AN APPROXIMATE TOP ELEVATION OF E. +3.5 FEET (NGVD 29) OR ABOUT EL. +2.4 FEET (NAVD 88).

REFERENCES

1.) BASE MAP SHOWN TAKEN FROM DIGITAL FILE 3074-02-TOPO.DWG, ENTITLED "BOROUGH OF CARLSTADT BLOCK 124 LOTS 1 THROUGH 5," DATED DECEMBER 8, 2005, PREPARED BY PROMAPS.

2.) LIMITS OF SLUDGE "HOT SPOT" AREA TAKEN FROM THE FOCUSED FEASIBILITY STUDY INVESTIGATION REPORT (GOLDER, 1997).

3.) HORIZONTAL DATUM REFERENCES THE NEW JERSEY STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83). VERTICAL DATUM REFERENCES THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

4000

0

80

SCALE

FEET

ELEVATION SUMMARY	
100 YEAR FLOOD PLAIN	7.2 ft
500 YEAR FLOOD PLAIN	7.6 ft
EXISTING SHEET PILE WALL	3.5 ft
PROPOSED SHEET PILE WALL	6.0 ft
MEAN HIGH WATER LEVEL	3.6 ft

REV

DATE

DES

REVISION DESCRIPTION

CADD

CHK

RVW

PROJECT

216 PATERSON PLANK ROAD SITE
FINAL DESIGN REPORT FOR OU-2
CARLSTADT, BERGEN COUNTY, NEW JERSEY

TITLE

SITE PLAN

NJ Authorization #240A28029100

Golder Associates
Philadelphia USA

PROJECT No.

943-6222

FILE No.

9436222Q001

DESIGN

VEF

05/07/07

CADD

RG

05/07/07

CHECK

MFM

05/07/07

REVIEW

RJI

05/07/07

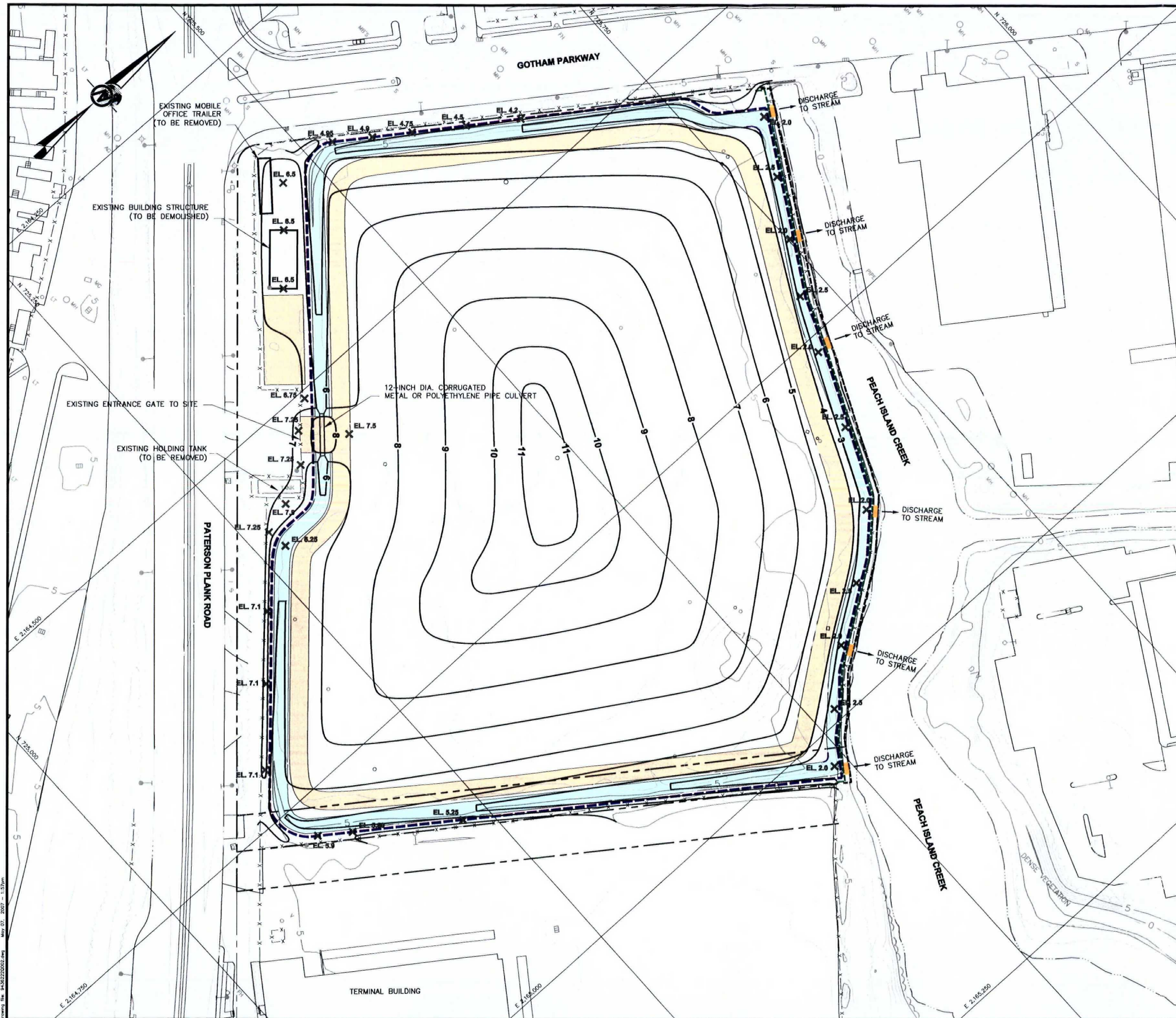
SCALE

AS SHOWN

REV. 0

FIGURE 3

Drawing File: 9436222Q001.dwg
Date: 07/05/2007
Time: 2:11pm



LEGEND

- EXISTING GROUND CONTOURS
- - - EDGE OF STREAM
- x - x - x - EXISTING FENCE
- - - PROPERTY LINE
- - - EXISTING SHEET PILE WALL (TO BE PARTIALLY REMOVED)
- - - NEW SHEET PILE WALL (SEE FIGURES 13 AND 14)
- WEIR (SEE NOTE 5)
- x EL. 2.5 SPOT ELEVATION
- - - LIMITS OF NEW GEOMEMBRANE (SEE NOTE 3)
- - - PROPOSED GROUND CONTOURS
- PERIMETER DRAINAGE CHANNEL (SEE DETAILS (2/5) AND (4/5))
- NEW PERIMETER ACCESS ROAD AND PARKING AREAS (SEE DETAILS (3/5) AND (5/5))

- NOTES**
- 1.) ALL LOCATIONS ARE APPROXIMATE.
 - 2.) CONTRACTOR MAY ELECT TO REMOVE PORTIONS OF THE EXISTING PERIMETER FENCE DURING CONSTRUCTION TO ACCOMMODATE ITS ACTIVITIES AND CONTRACTOR SHALL PROVIDE TEMPORARY ACCESS RESTRICTIONS IN AREAS WHERE THE EXISTING FENCE IS REMOVED. ALL REMOVED SECTIONS OF EXISTING FENCE SHALL BE RESTORED TO ITS ORIGINAL CONDITION, OR BETTER, UPON COMPLETION OF CONSTRUCTION.
 - 3.) LIMITS OF THE NEW GEOMEMBRANE SHALL COINCIDE WITH THE LIMITS OF THE EXISTING GEOMEMBRANE. ACTUAL LIMITS OF EXISTING GEOMEMBRANE ARE NOT KNOWN WITH CERTAINTY AND WILL BE FIELD VERIFIED.
 - 4.) CONTRACTOR SHALL PROTECT ALL STRUCTURES, FENCELINES, WELLS, AND OTHER SITE FEATURES DURING CONSTRUCTION, UNLESS INDICATED OTHERWISE ON THESE DRAWINGS, OR AS DIRECTED BY THE GROUP'S REPRESENTATIVE. CONTRACTOR SHALL REPLACE ANY DAMAGED ITEMS AT ITS SOLE EXPENSE.
 - 5.) SURFACE WATER FLOWS SHALL BE CONVEYED TO PEACH ISLAND CREEK VIA THE PERIMETER DRAINAGE CHANNELS, AND DISCHARGE TO CREEK THROUGH A SERIES OF WEIRS IN THE TOPS OF THE NEW SHEET PILE WALLS.
 - 6.) LIMITS OF NEW GEOMEMBRANE AND PROPOSED CONTOURS MAY BE ADJUSTED IN THE FIELD TO ACCOUNT FOR ACTUAL FIELD CONDITIONS.

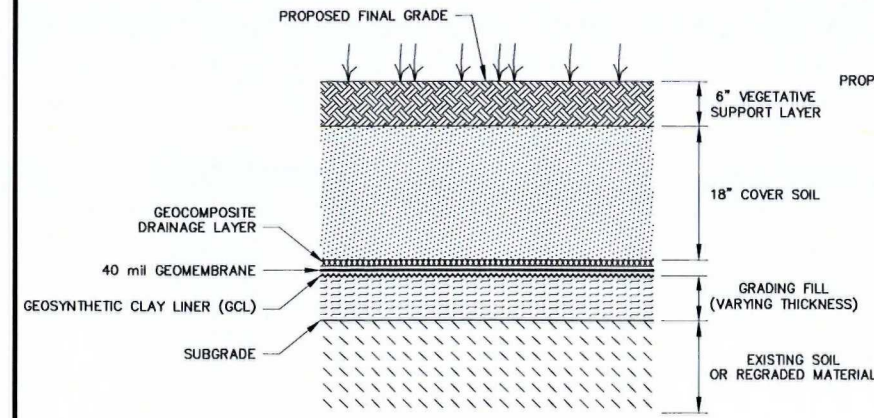
- REFERENCES**
- 1.) BASE MAP SHOWN TAKEN FROM DIGITAL FILE 3074-02-TOPO.DWG, ENTITLED "BOROUGH OF CARLSTADT BLOCK 124 LOTS 1 THROUGH 5," DATED DECEMBER 8, 2005, PREPARED BY PROMAPS.
 - 2.) HORIZONTAL DATUM REFERENCES THE NEW JERSEY STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83). VERTICAL DATUM REFERENCES THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).



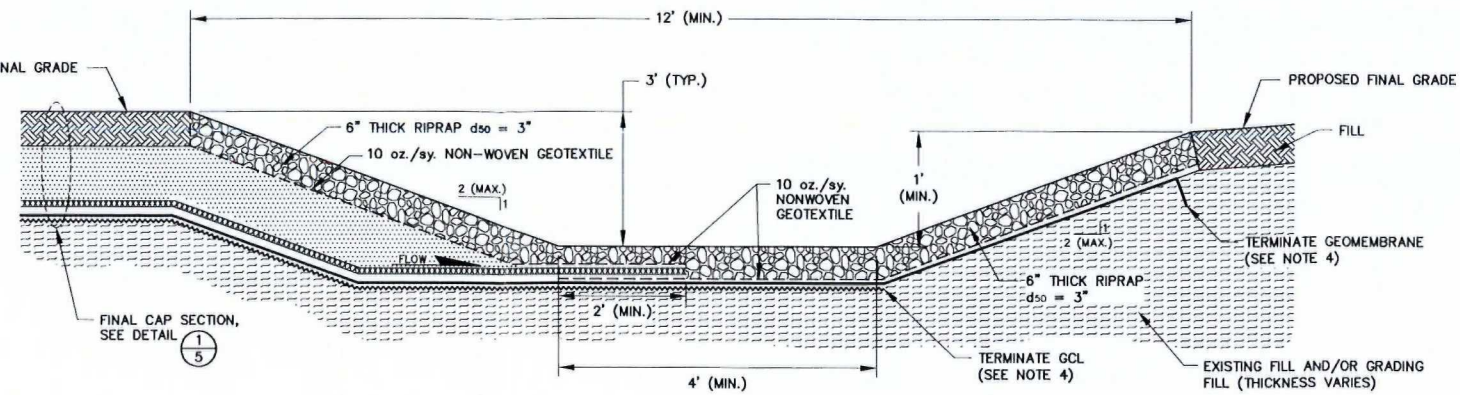
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PROJECT						
216 PATERSON PLANK ROAD SITE FINAL DESIGN REPORT FOR OU-2 CARLSTADT, BERGEN COUNTY, NEW JERSEY						
TITLE						
GRADING AND DRAINAGE PLAN						
NJ Authorization #240A28029100						
PROJECT No.			943-6222	FILE No.		
DESIGN			VEF 05/07/07	SCALE		
CADD			RG 05/07/07	AS SHOWN		
CHECK			MFM 05/07/07	REV.		
REVIEW			RJI 05/07/07	0		



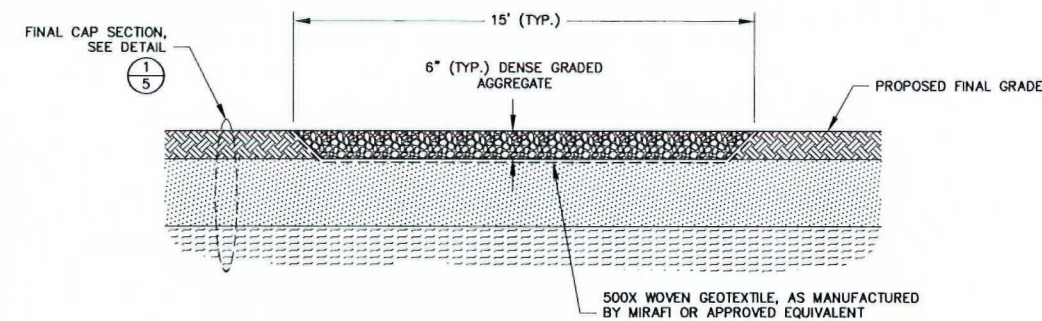
FIGURE 4



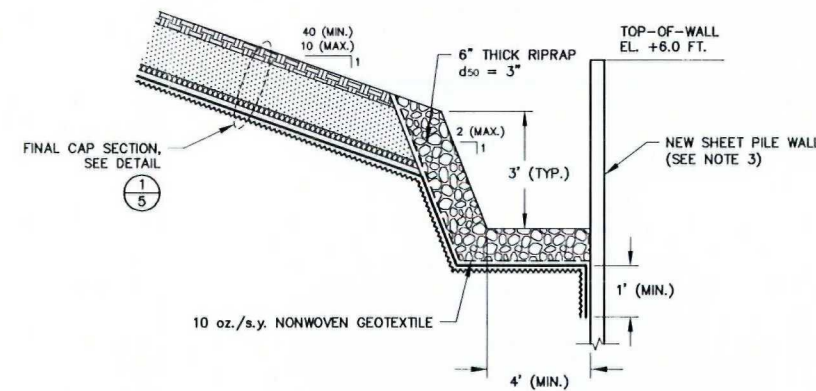
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5 **FINAL CAP SECTION**
NOT TO SCALE
(SEE NOTES 1 AND 4)



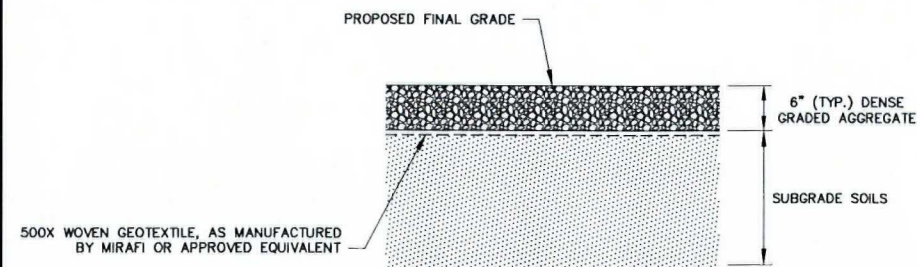
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5 **TYPICAL PERIMETER DRAINAGE CHANNEL DETAIL**
NOT TO SCALE
(SEE NOTES 1 AND 4)



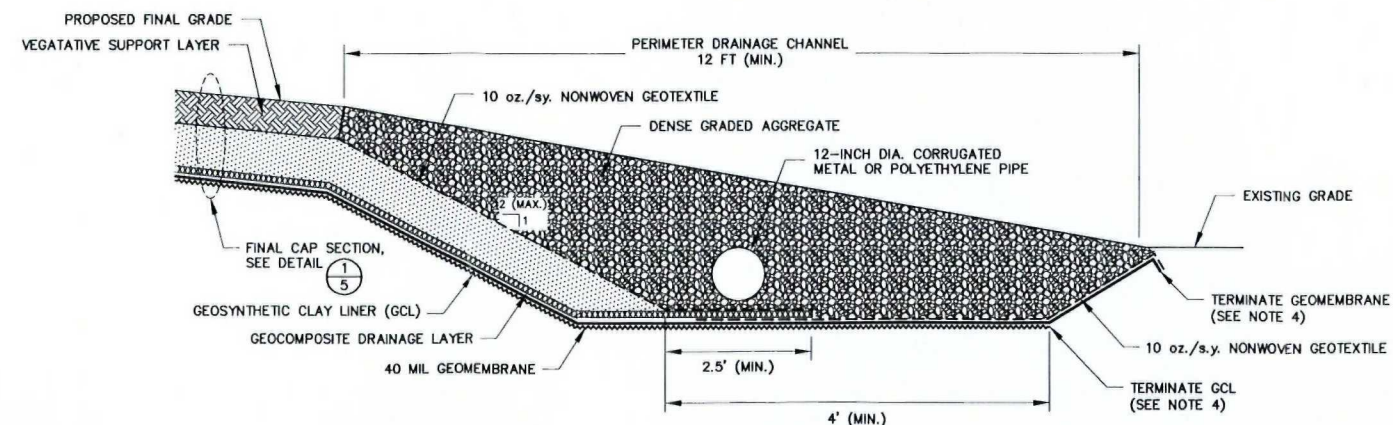
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5 **ACCESS ROAD DETAIL**
NOT TO SCALE
(SEE NOTE 2)



4
5 **PERIMETER DRAINAGE CHANNEL DETAIL
ALONG NEW SHEET PILE WALL**
NOT TO SCALE
(SEE NOTES 1, 2, 3 AND 4)



5
5 **ACCESS ROAD
AND PARKING AREA SECTION**
NOT TO SCALE



6
5 **ENTRANCE ROADWAY CULVERT DETAIL**
NOT TO SCALE
(SEE NOTES 1 AND 4)

NOTES

- 1.) GEOSYNTHETICS THICKNESSES ARE EXAGGERATED FOR CLARITY.
- 2.) ALIGNMENTS OF PROPOSED ACCESS ROADS SHALL FOLLOW THE PROPOSED CONTOURS SHOWN ON FIGURE 4. LOCATIONS, WIDTHS, GRADES, AND ALIGNMENTS OF ACCESS ROADS MAY BE MODIFIED DURING CONSTRUCTION, BY THE REMEDIAL DESIGNER, AS NECESSARY.
- 3.) SEE FIGURES 13 AND 14 FOR SHEET PILE WALL PLAN AND DETAILS, RESPECTIVELY.
- 4.) CONTRACTOR SHALL PREPARE AND SUBMIT, AS PART OF ITS REQUISITE SHOP DRAWINGS, TYPICAL CONSTRUCTION AND TERMINATION DETAILS FOR ALL COMPONENTS OF THE PROPOSED COVER SYSTEM, AND THESE DETAILS SHALL CONFORM AND MEET ALL MANUFACTURER RECOMMENDATIONS AND REQUIREMENTS.

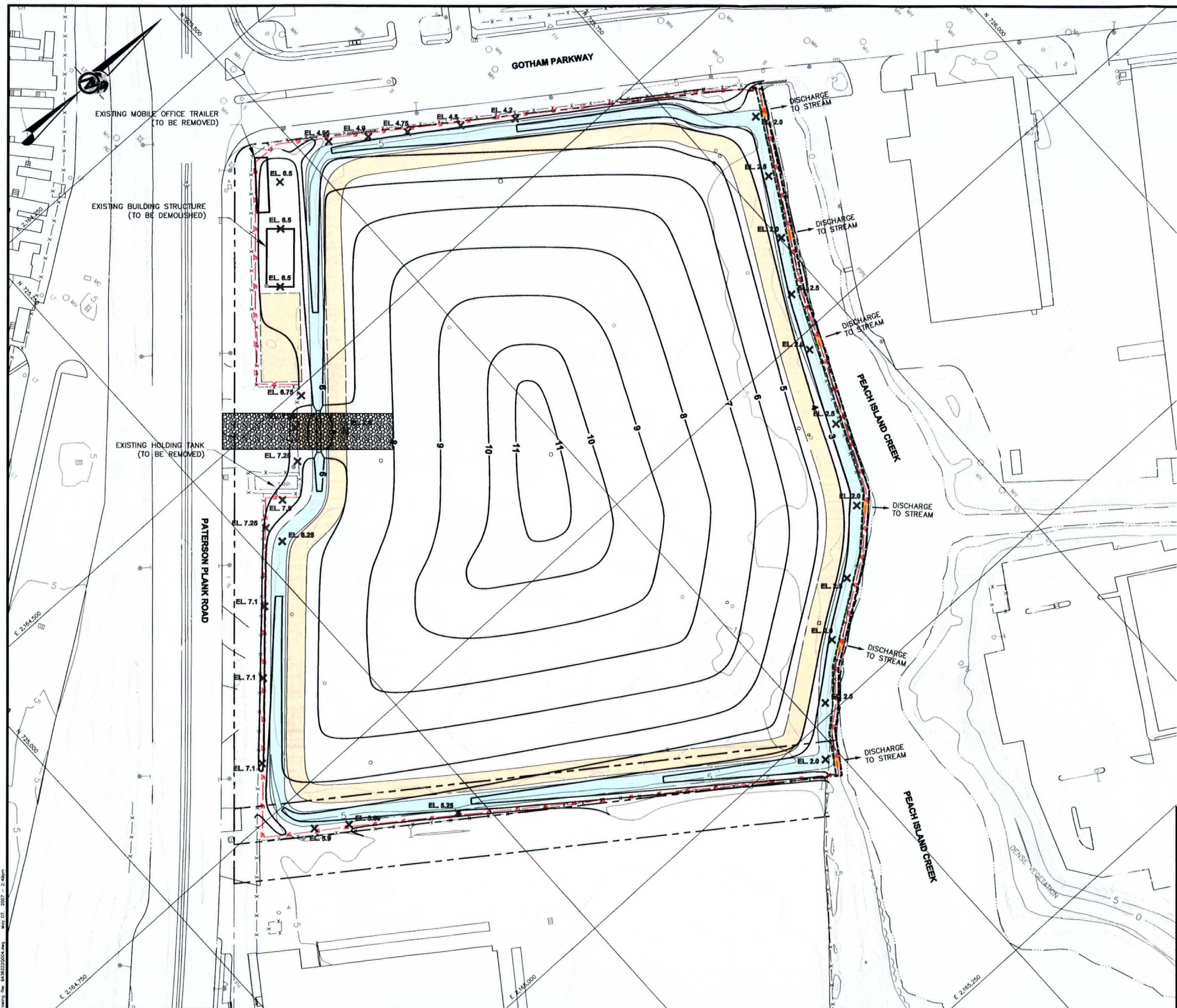
REFERENCE

- 1.) VERTICAL DATUM REFERENCES THE NORTH AMERICAN DATUM OF 1988 (NAVD 1988).

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
PROJECT						
216 PATERSON PLANK ROAD SITE FINAL DESIGN REPORT FOR OU-2 CARLSTADT, BERGEN COUNTY, NEW JERSEY						
TITLE						
GRADING AND DRAINAGE DETAILS						
PROJECT No. 943-6222			FILE No. 94362220003			
DESIGN	VEF	05/07/07	SCALE	AS SHOWN	REV.	0
CADD	RG	05/07/07				
CHECK	MFM	05/07/07				
REVIEW	RJ	05/07/07				



FIGURE 5



LEGEND

- 5
- EDGE OF STREAM
- X X X X X
- EXISTING FENCE
- — — — —
- PROPERTY LINE
- — — — —
- EXISTING SHEET PILE WALL (TO BE PARTIALLY REMOVED)
- — — — —
- NEW SHEET PILE WALL
-
- WEIR (SEE NOTE 5)
- X EL. 2.5
- SPOT ELEVATION
- 13 —
- PROPOSED GROUND CONTOURS
- S — S —
- SILT FENCE, SEE DETAIL (1/7)
-
- TEMPORARY STABILIZED CONSTRUCTION ENTRANCE,
SEE DETAIL (3/7)
- — — — —
- PERIMETER DRAINAGE CHANNEL (SEE DETAILS (2/5) AND (4/5))
- — — — —
- NEW PERIMETER ACCESS ROAD AND PARKING AREAS
(SEE DETAILS (3/5) AND (5/5))

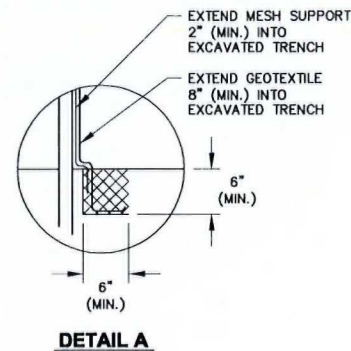
NOTES

- 1.) ALL LOCATIONS ARE APPROXIMATE.
- 2.) TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES AND LOCATIONS SHOWN HEREIN ARE GENERAL MEASURES TO BE INSTALLED DURING CONSTRUCTION. ACTUAL LOCATIONS, SIZES, AND TYPES OF TEMPORARY MEASURES WILL BE SELECTED BY THE CONTRACTOR BASED UPON ITS CONSTRUCTION SEQUENCING.
- 3.) CONTRACTOR SHALL BE REQUIRED TO SUBMIT FOR FAVORABLE REVIEW AN EROSION AND SEDIMENT CONTROL PLAN, SHOWING THEIR CONSTRUCTION SEQUENCING AND PROPOSED TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES TO BE IMPLEMENTED.
- 4.) TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE CONSTRUCTED AND MAINTAINED IN COMPLIANCE WITH THE RECOMMENDATIONS INCLUDED IN THE "STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY."
- 5.) SURFACE WATER FLOWS SHALL BE CONVEYED TO PEACH ISLAND CREEK VIA THE PERIMETER DRAINAGE CHANNELS, AND DISCHARGE TO CREEK THROUGH A SERIES OF WEIRS IN THE TOPS OF THE SHEET PILE WALLS.
- 6.) SEE SECTION 02125 OF TECHNICAL SPECIFICATIONS FOR ADDITIONAL DETAILS AND REQUIREMENTS RELATED TO THE SPECIFIED TEMPORARY EROSION AND SEDIMENT CONTROL OPERATIONS.
- 7.) EROSION CONTROL MEASURES SHALL BE MAINTAINED AND MOVED, AS NECESSARY, TO FACILITATE CONSTRUCTION ACTIVITIES.

REFERENCES

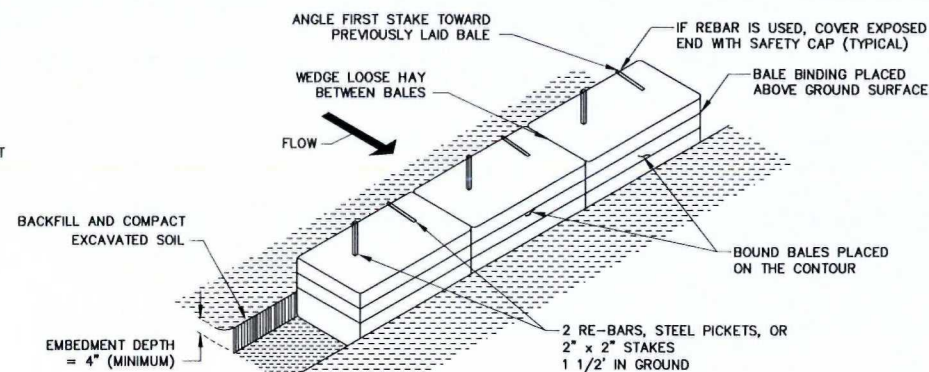
- 1.) BASE MAP SHOWN TAKEN FROM DIGITAL FILE 3074-02-TOPO.DWG, ENTITLED "BOROUGH OF CARLSTADT BLOCK 124 LOTS 1 THROUGH 5," DATED DECEMBER 8, 2005, PREPARED BY PROMAPS.
- 2.) HORIZONTAL DATUM REFERENCES THE NEW JERSEY STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83). VERTICAL DATUM REFERENCES THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

[illegible]

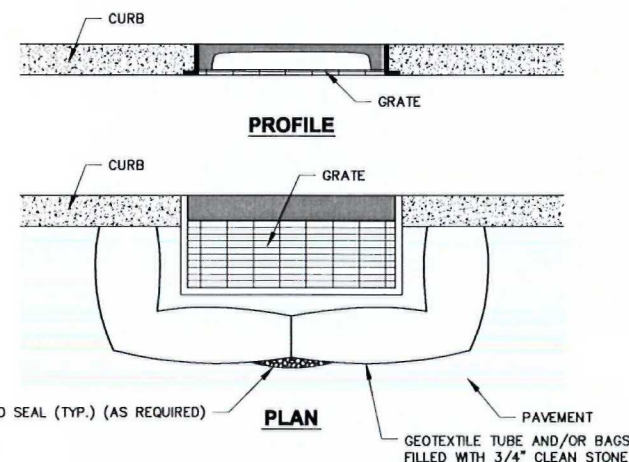


- 1.) WOVEN WIRE FENCE TO BE FASTENED SECURELY TO FENCE POSTS WITH HEAVY DUTY WIRE STAPLES AT LEAST 1" LONG, TIE WIRES OR HOG RINGS.
- 2.) SILT FENCE GEOTEXTILE TO BE FASTENED SECURELY TO WOVEN WIRE FENCE WITH TIES SPACED EVERY 24" AT TOP AND MID-SECTION IF POSTS ARE GREATER.
- 3.) FILTER FABRIC FENCE MUST BE PLACED AT LEVEL EXISTING GRADE. BOTH ENDS OF THE BARRIER MUST BE EXTENDED AT LEAST 8 FEET UP SLOPE AT 45 DEGREES TO THE MAIN BARRIER ALIGNMENT.
- 4.) SEDIMENT MUST BE REMOVED WHEN ACCUMULATIONS REACH 1/2 THE ABOVE GROUND HEIGHT OF THE FENCE.
- 5.) ANY SECTION OF FILTER FABRIC FENCE WHICH HAS BEEN UNDERMINED OR TOPPED MUST BE IMMEDIATELY REPLACED WITH A ROCK FILTER OULET.

POSTS: STEEL EITHER T OR U TYPE OR 2" HARDWOOD
FENCE: WOVEN WIRE, 14 1/2 GA. 6" MAX. MESH OPENING
GEOTEXTILE: FILTER X, MIRAFI 100X OR APPROVED
APPROVED EQUIVALENT
PREFABRICATED UNIT: GEOFAB, ENVIROFENCE, OR
APPROVED EQUIVALENT

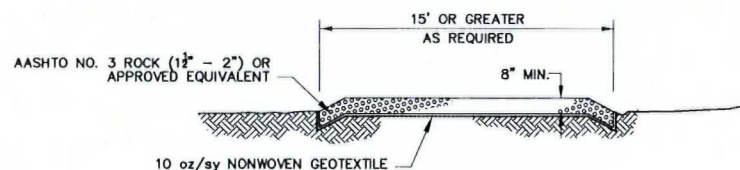


2 HAY BALE DETAIL



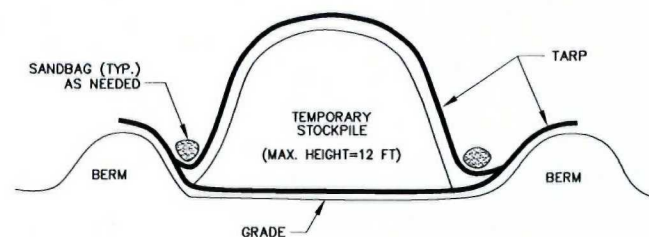
4 **INLET PROTECTION DETAIL**
7 NOT TO SCALE

- 1.) GEOTEXTILE TO BE WOVEN POLYPROPYLENE PRODUCT 117F, BY SYNTHETIC INDUSTRIES INC., OR TERRATEX SC. BY WEBTEX INC., OR APPROVED EQUAL.
- 2.) 3/4" CLEAN STONE CORE SHALL BE COMPLETELY CONTAINED WITHIN GEOTEXTILE. SEAMS SHALL BE SEWN OR CLOSED BY SUITABLE MECHANICAL MEANS TO PREVENT LEAKAGE OF STONE.
- 3.) WHERE NO CURB IS PRESENT, BARRIER SHALL COMPLETELY ENIRCLE THE DRAIN INLET.
- 4.) INLET GRATE OPENING IS TO BE KEPT CLEAR OF OBSTRUCTIONS AT ALL TIMES.
- 5.) THE PROTECTION DEVICE WILL BE DESIGNED TO CAPTURE OR FILTER RUNOFF FROM THE 1-YEAR, 24-HOUR STORM EVENT AND SHALL SAFELY CONVEY HIGHER FLOWS DIRECTLY INTO THE STORM SEWER SYSTEM. WHERE SLOPE REQUIRES, AN EARTHEN BERM SHALL BE INSTALLED TO DIRECT STORM FLOW INTO THE INLET, BUT NOT OVER THE CURB.
- 6.) OTHER METHODS THAT ACCOMPLISH THE PURPOSE OF STORM SEWER INLET PROTECTION MAY BE USED IF APPROVED BY THE SOIL CONSERVATION DISTRICT.
- 7.) INSPECTIONS SHALL BE FREQUENT. MAINTENANCE, REPAIR, AND REPLACEMENT SHALL BE MADE PROMPTLY, AS NEEDED. THE BARRIER SHALL BE REMOVED WHEN THE AREA DRAINING TOWARDS THE INLET HAS BEEN STABILIZED.



NOTE: CONTRACTOR SHALL PROVIDE APPROPRIATE TRANSITION BETWEEN STABILIZED CONSTRUCTION ENTRANCE AND PUBLIC RIGHT-OF-WAYS


3 7 STABILIZED CONSTRUCTION ENTRANCE DETAIL NOT TO SCALE

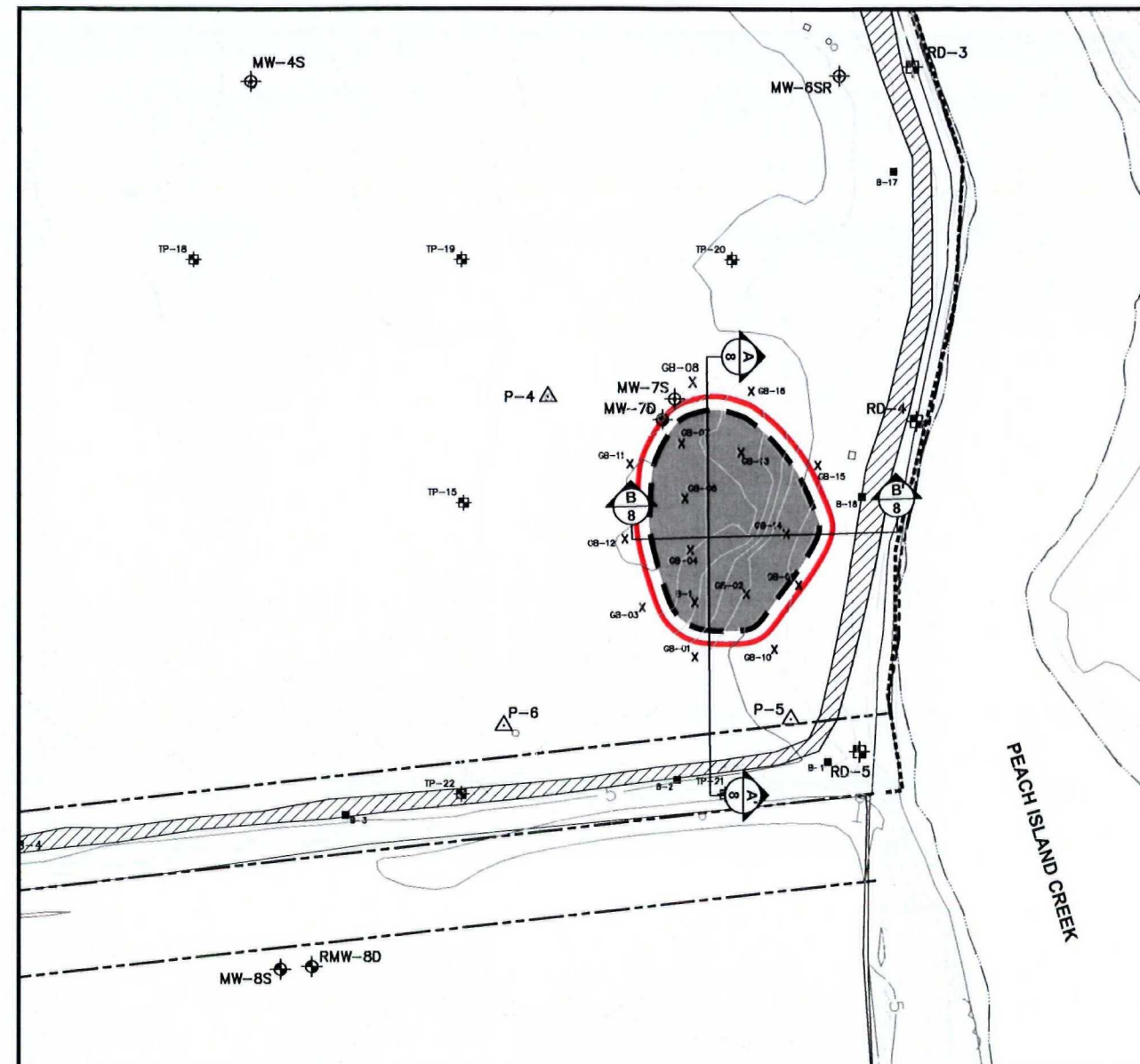


5 7 TEMPORARY SOIL STOCKPILE DETAIL NOT TO SCALE

- BERGEN COUNTY CONSERVATION DISTRICT**
SOIL EROSION AND SEDIMENT CONTROL (SESC) NOTES

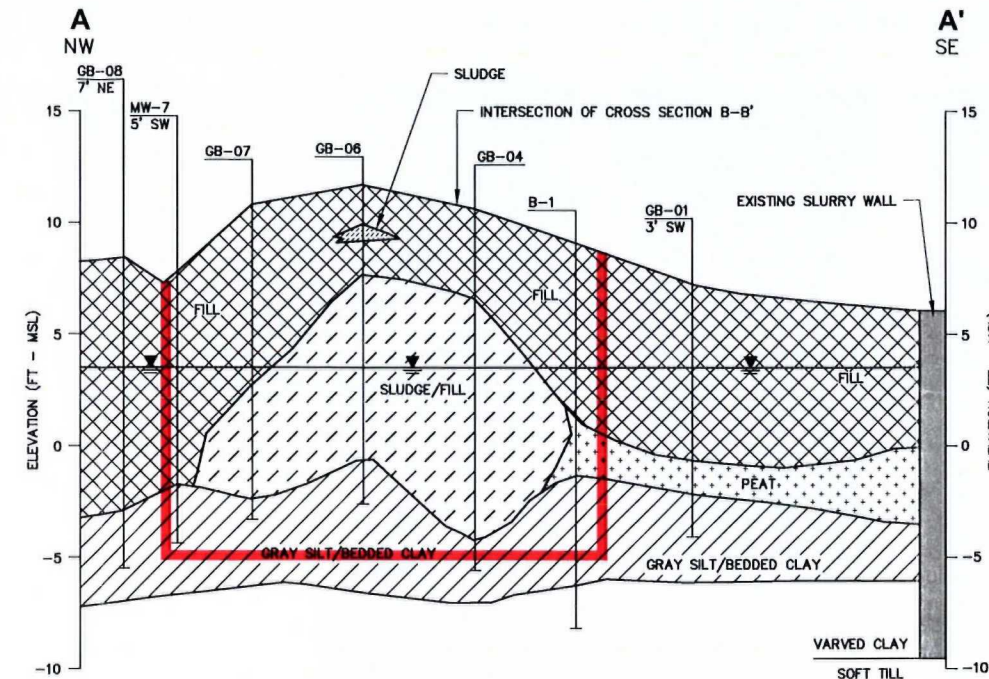
1. All soil erosion and sediment control practices will be installed in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey (NJ Standards), and will be installed in proper sequence and maintained until permanent stabilization is established.
2. Any disturbed area that will be left exposed for more than thirty (30) days and not subject to construction traffic shall immediately receive a temporary seeding and mulching. If the season prohibits temporary seeding, the disturbed area will be mulched with salt hay or equivalent and bound in accordance with the NJ Standards (i.e. peg and twine, mulch netting, or liquid mulch binder).
3. Immediately following initial disturbance or rough grading, all critical areas subject to erosion will receive a temporary seeding in combination with straw mulch or a suitable equivalent, at a rate of 2 tons per acre, according to the NJ Standards.
4. Stabilization Specifications:
 - A. Temporary Seeding and Mulching:
 - Lime – 50 lbs/1,000 sf of ground limestone, Fertilizer – 11 lbs/1,000 sf, 10-20-10 or equivalent worked into the soil a minimum of 4”.
 - Seed – perennial ryegrass 40 lbs/acre (1 lb/1,000 sf) or other approved seeds, plant between March 1 and May 15 or between August 15 and October 1.
 - Mulch – salt hay or small grain straw at a rate of 70 to 90- lbs/1,000 sf to be applied according to NJ Standards. Mulch shall be secured by approved methods (i.e. peg and twine, mulch netting, or liquid mulch binder).
 - B. Permanent Seeding and Mulching
 - Topsoil – uniform application to a depth of 5” (unsettled)
 - Lime – 50 lbs/1,000 sf of ground limestone, Fertilizer – 11 lbs/1,000 sf, 10-20-10 or equivalent worked into the soil a minimum of 4”.
 - Seed – Turf type tall fescue (blend of 3 cultivars) 150 lbs/acre (3.5 lbs/1,000 sf) or other approved seeds, plant between March 1 and November 15.
 - Mulch – salt hay or small grain straw at a rate of 70 to 90- lbs/1,000 sf to be applied according to NJ Standards. Mulch shall be secured by approved methods (i.e. peg and twine, mulch netting, or liquid mulch binder).
5. The site shall at all times be graded and maintained such that all stormwater runoff is diverted to soil erosion and sediment control facilities.
6. Soil erosion and sediment control measures will be inspected and maintained on a regular basis, including after every storm event.
7. Stockpiles shall not be located within 50’ of a floodplain, slope, roadway or drainage facility. The base of all stockpiles shall be contained by a haybale sediment barrier or silt fence.
8. A crushed stone, vehicle wheel-cleaning blanket will be installed wherever a construction access road intersects any paved roadway. Said blanket will be composed of 1”-2½” crushed stone, 8” thick, will be at least 30’ x 100’ and should be underlain with a suitable synthetic sediment filter fabric and maintained.
9. Maximum side slopes of all exposed surfaces shall not exceed 3:1 unless otherwise approved by the District.
10. Driveways must be stabilized with 1”-2½” crushed stone or subbase prior to individual lot construction.
11. All soil washed, dropped, spiled or tracked outside the limit of disturbance or onto public right-of-ways, will be removed immediately. Paved roadways must be kept clean at all times.
12. Catch basin inlets will be protected with an inlet filter design in accordance with Section 30-1 of the NJ Standards.
13. Storm drainage outlets will be stabilized, as required, before discharge points become operational.
14. Dewatering operations must discharge directly into a sediment control bag or other approved filter in accordance with Section 14-1 of the NJ Standards.
15. Dust shall be controlled via the application of water, calcium chloride or other approved method in accordance with Section 16-1 of the NJ Standards.
16. Trees to remain after construction are to be protected with a suitable fence installed at the drip line or beyond in accordance with Section 19-1 of the NJ Standards.
17. The project owner shall be responsible for any erosion or sedimentation that may occur below stormwater outfalls or off-site as a result of construction of the project.
18. Any revision to the certified Soil Erosion and Sediment Control Plan must be submitted to the District for review and approval prior to implementation in the field.
19. A copy of the certified Soil Erosion and Sediment Control Plan must be available at the project site throughout construction.
20. The Bergen County Soil Conservation District must be notified, **in writing**, at least 48 hours prior to any land disturbance. Bergen County SCD, 700 Kinderkamack Road, Suite 106, Oradell, NJ 07649. Tel: 201-261-4407; Fax: 201-261-7573.
21. The Bergen County Soil Conservation District may request additional measures to minimize on or off-site erosion problems during construction.
22. The owner must obtain a District issued report of compliance prior to the issuance of any certificate of occupancy. **The District requires at least one week’s notice to facilitate the scheduling of all report of compliance inspections.** All site work must be completed, including temporary/permanent stabilization of all exposed areas, prior to the issuance of a report of compliance by the District.

REV	DATE	DES	REVISION DESCRIPTION				CADD	CHK	RWN	
PROJECT			216 PATERSON PLANK ROAD SITE FINAL DESIGN REPORT FOR OU-2 CARLSTADT, BERGEN COUNTY, NEW JERSEY							
TITLE										
SOIL EROSION AND SEDIMENT CONTROL DETAILS										
 Golder Associates Philadelphia USA			PROJECT No.		943-6222		FILE No.		9436222Q005	
			DESIGN	VEF	05/07/07		SCALE	AS SHOWN	REV.	0
			CADD	RG	05/07/07					
			CHECK	MM	05/07/07					
			REVIEW	RJ	05/07/07					
			FIGURE 7							

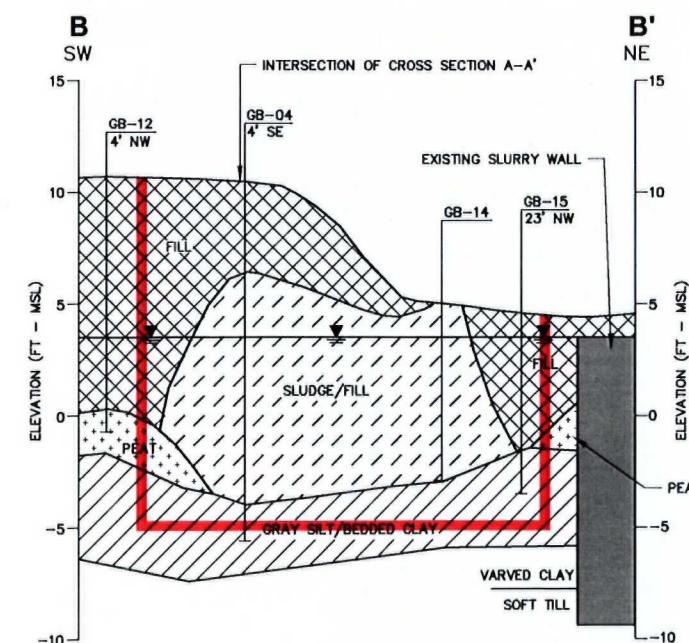


1 IN-SITU "HOT SPOT" TREATMENT PLAN
8

30 0 30 60
SCALE FEET



A **SECTION A-A'**
8 NOT TO SCALE



B SECTION B-B'
8 NOT TO SCALE

LEGEND

- FIGURE No. WHERE DETAIL OR CROSS SECTION IS PRESENTED**
- EXISTING GROUND CONTOURS**
- EDGE OF STREAM**
- EXISTING FENCE**
- PROPERTY LINE**
- EXISTING SLURRY WALL**
- EXISTING SHEET PILE WALL (TO BE PARTIALLY REMOVED)**
- LIMITS OF IN-SITU "HOT SPOT" TREATMENT (SEE REFERENCE 2)**
- EXISTING UTILITY POLE**
- EXISTING GROUNDWATER EXTRACTION WELLS (TO BE REMOVED)**
- EXISTING GROUNDWATER MONITORING WELLS**
- EXISTING PIEZOMETERS**
- PRE-DESIGN INVESTIGATION BORINGS**
- SOIL BORING LOCATIONS
(COMPLETED AS PART OF THE FFSI)**
- SLURRY WALL CONSTRUCTION INVESTIGATION BORINGS
(DRILLED AS PART OF THE OU-1 INTERIM REMEDIAL DESIGN)**
- TEST PITS (EXCAVATED AS PART OF THE RI)**
- LIMITS OF SLUDGE "HOT SPOT" AREA (SEE REFERENCE 2)**

NOTES

- 1.) ALL LOCATIONS ARE APPROXIMATE.
- 2.) SEE SECTION 02450 OF THE TECHNICAL SPECIFICATIONS FOR ADDITIONAL DETAILS AND REQUIREMENTS FOR THE SPECIFIED IN-SITU "HOT SPOT" TREATMENT OPERATIONS.


REFERENCES

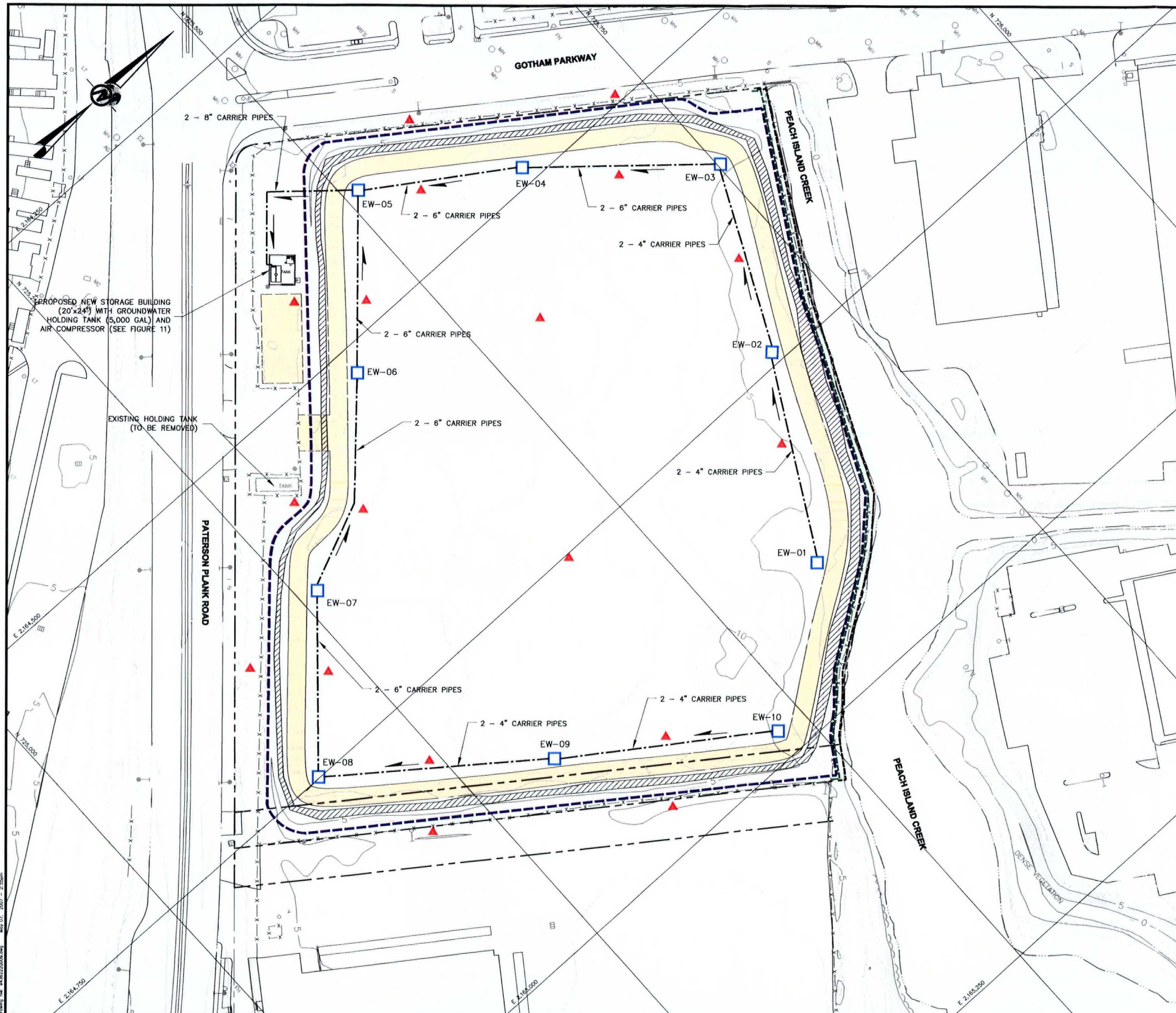
- 1.) BASE MAP SHOWN TAKEN FROM DIGITAL FILE 3074-02-TOPO.DWG, ENTITLED "BOROUGH OF CARLSTADT BLOCK 124 LOTS 1 THROUGH 5," DATED DECEMBER 8, 2005, PREPARED BY PROMAPS.
- 2.) LIMITS OF SLUDGE AREA TAKEN FROM THE FOCUSED FEASIBILITY STUDY INVESTIGATION REPORT (GOLDER, 1997).
- 3.) HORIZONTAL DATUM REFERENCES THE NEW JERSEY STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83). VERTICAL DATUM REFERENCES THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RWV
PROJECT						

216 PATERSON PLANK ROAD SITE
FINAL DESIGN REPORT FOR OU-2
CARLSTADT, BERGEN COUNTY, NEW JERSEY

TITLE	IN-SITU "HOT SPOT" TREATMENT PLAN AND DETAILS
-------	--

 Golder Associates Philadelphia USA	NJ Authorization #240A28029100		PROJECT No.	943-6222	FILE No.	9436222Q008
	DESIGN	VEF	05/07/07	SCALE	AS SHOWN	REV. 0
	CADD	RG	05/07/07	<div style="text-align: center; font-size: 2em; font-weight: bold;">FIGURE 8</div>		
	CHECK	MFV	05/07/07			
	REVIEW	RJL	05/07/07			



LEGEND

- 5 — EXISTING GROUND CONTOURS
- - - - - EDGE OF STREAM
- x - x - x - EXISTING FENCE
- - - - - PROPERTY LINE
- EXISTING SLURRY WALL
- - - - - EXISTING SHEET PILE WALL (TO BE PARTIALLY REMOVED)
- - - - - NEW SHEET PILE WALL
- - - - - LIMITS OF NEW GEOMEMBRANE
- - - - - PROPOSED CARRIER PIPE FOR LIQUID AND AIR LINES
- ▲ NEW PIEZOMETERS (SEE DETAIL 1/10)
- EW-01 PROPOSED GROUNDWATER EXTRACTION WELLS (SEE DETAIL 2/10)
- FLOW DIRECTION
- NEW PERIMETER ACCESS ROAD AND PARKING AREAS (SEE DETAILS 3/5 AND 5/5)

NOTES

- 1.) ALL LOCATIONS ARE APPROXIMATE.
- 2.) ALL CARRIER PIPES SHALL BE HDPE SDR-17, OR APPROVED EQUAL, SIZES VARY AS SHOWN HEREIN.
- 3.) LOCATIONS OF NEW EXTRACTION WELLS, CARRIER PIPES, AND PIEZOMETERS SHALL BE ESTABLISHED, BY THE REMEDIAL DESIGNER, IN THE FIELD DURING CONSTRUCTION.
- 4.) SECONDARY CARRIER PIPES SHALL BE SEALED/CAPPED AT TANK CONNECTION AND IN ALL INSTALLED EXTRACTION WELL VAULTS.
- 5.) ACTUAL LOCATIONS OF NEW EXTRACTION WELLS AND PIEZOMETERS MAY BE DIFFERENT FROM THOSE INDICATED HEREIN TO ACCOMMODATE FOR ACTUAL FIELD CONDITIONS.

REFERENCES

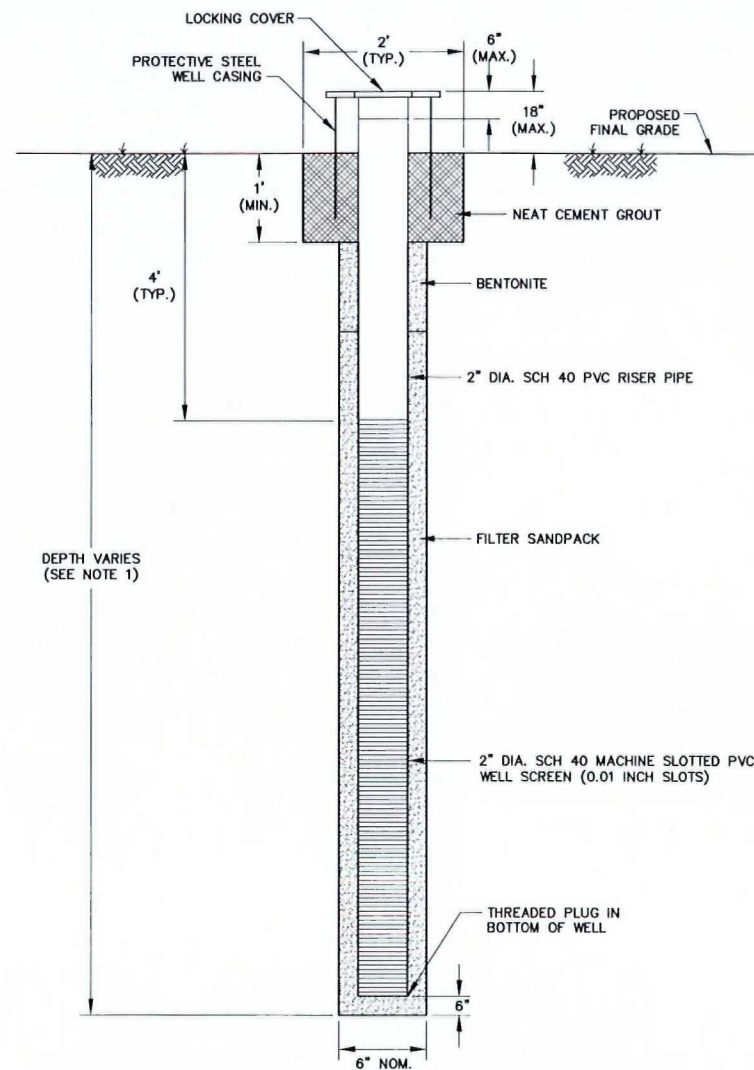
- 1.) BASE MAP SHOWN TAKEN FROM DIGITAL FILE 3074-02-TOPO.DWG, ENTITLED "BOROUGH OF CARLSTADT BLOCK 124 LOTS 1 THROUGH 5," DATED DECEMBER 8, 2005, PREPARED BY PROMAPS.
- 2.) HORIZONTAL DATUM REFERENCES THE NEW JERSEY STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83). VERTICAL DATUM REFERENCES THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).



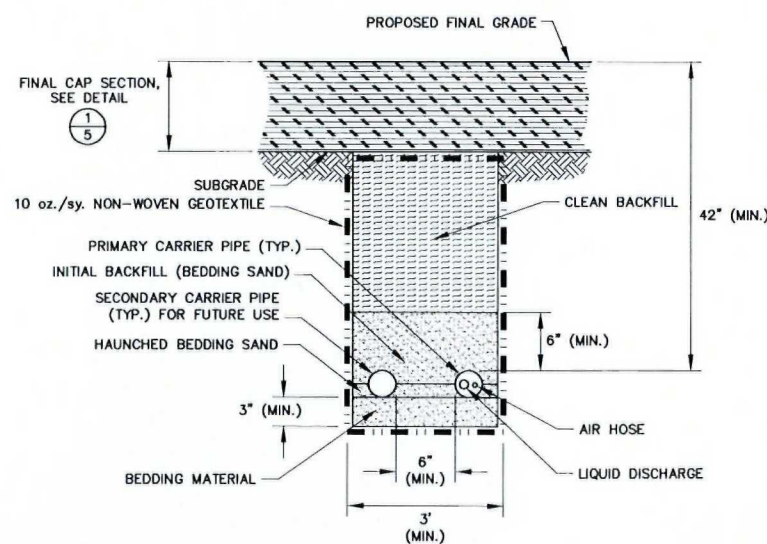
REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
PROJECT						
216 PATERSON PLANK ROAD SITE FINAL DESIGN REPORT FOR OU-2 CARLSTADT, BERGEN COUNTY, NEW JERSEY						
TITLE						
GROUNDWATER RECOVERY SYSTEM PLAN						
NJ Authorization #24A28029100						
PROJECT No.			943-6222	FILE No.		
DESIGN			KGK 05/07/07	SCALE		
CADD			RG 05/07/07	AS SHOWN		
CHECK			KGK 05/07/07	REV.		
REVIEW			MFM 05/07/07	0		



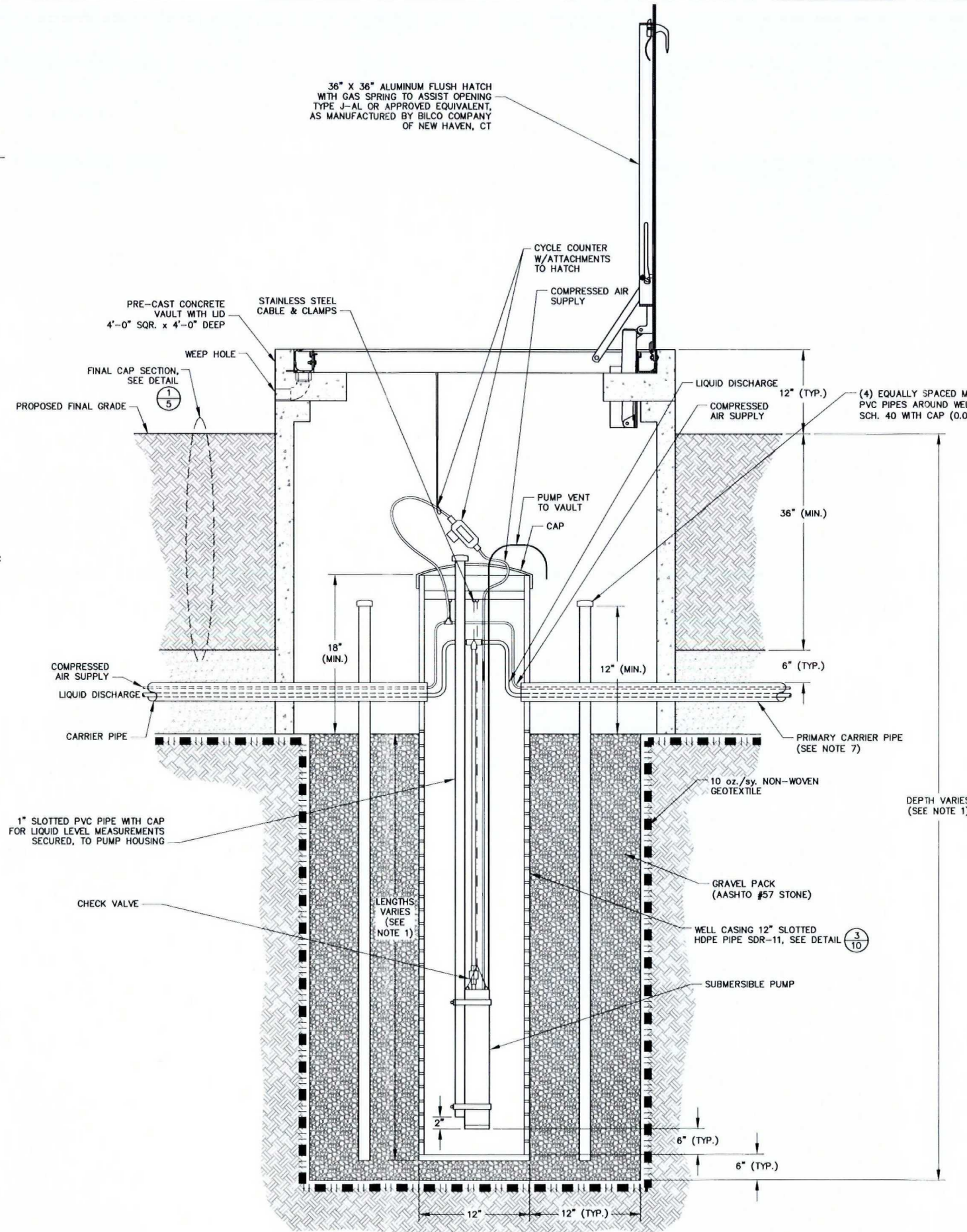
FIGURE 9



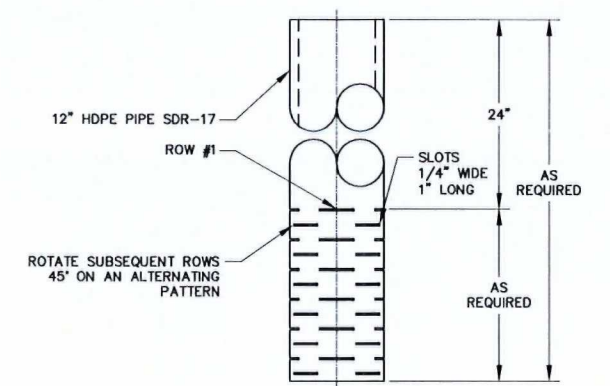
1
10 **PIEZOMETER DETAIL**
NOT TO SCALE



4
10 **CLEAN TRENCH CORRIDOR**
NOT TO SCALE



2
10 **GROUNDWATER EXTRACTION WELLS**
NOT TO SCALE

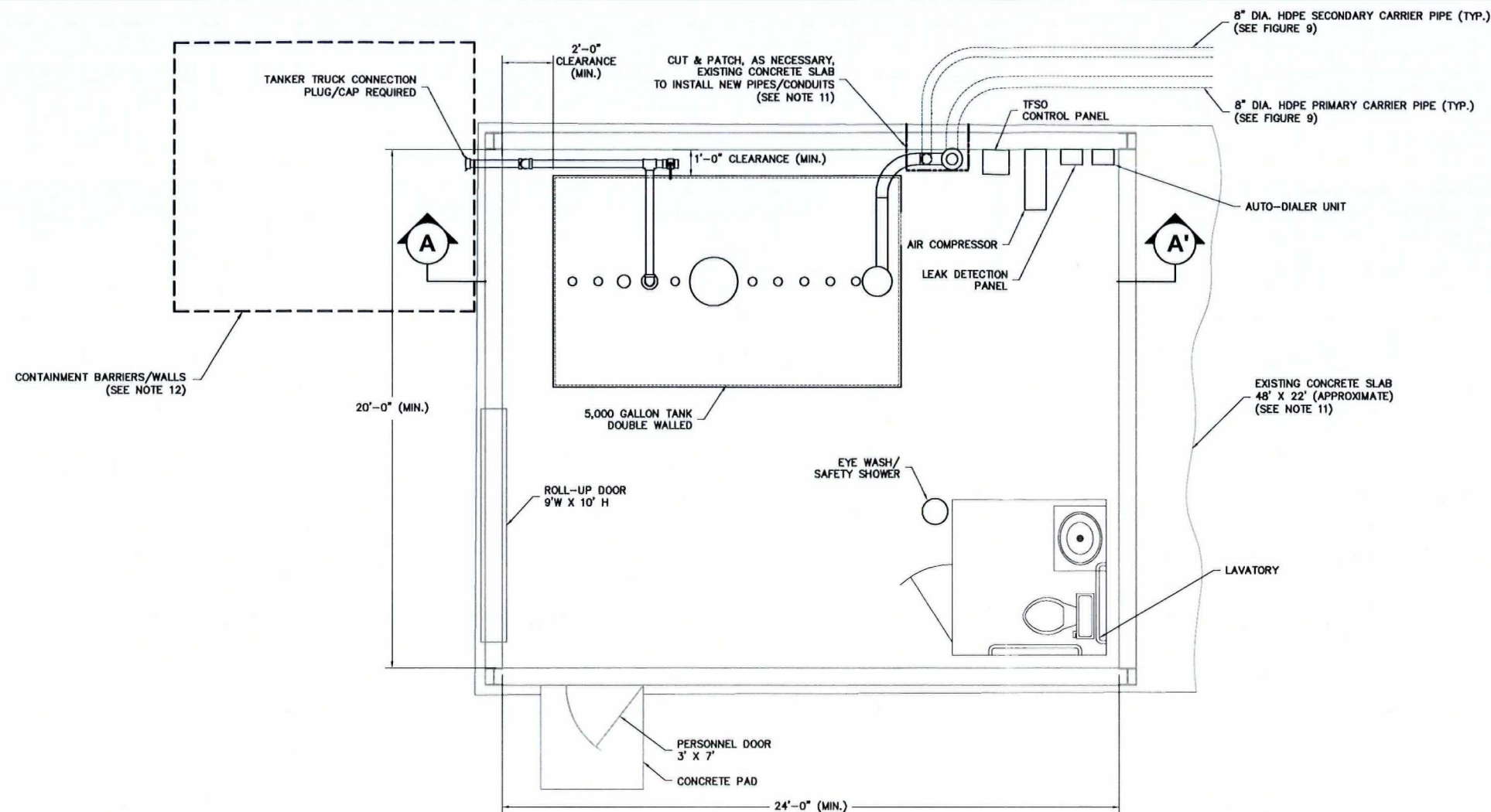


3
10 **SLOTTED WELL CASING**
NOT TO SCALE (SEE NOTE 2)

NOTES

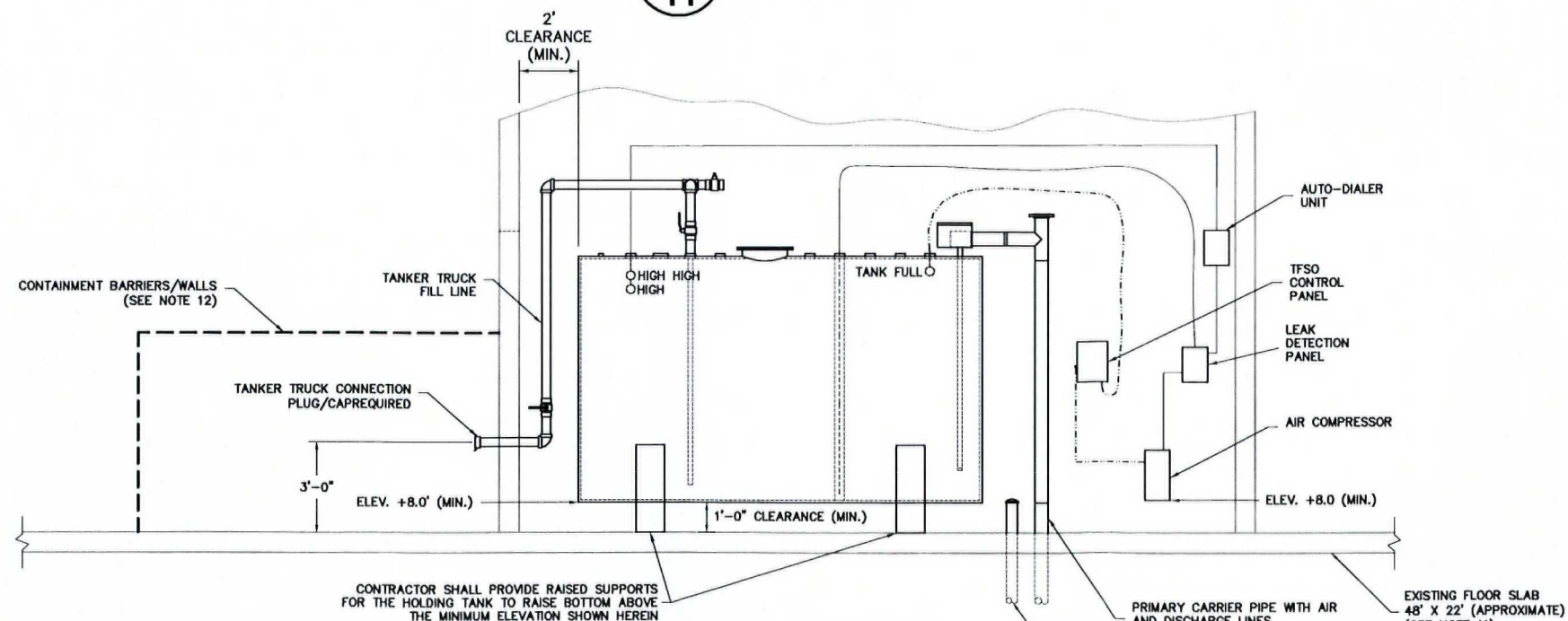
- 1.) DEPTH OF WELLS SHALL VARY BASED ON ACTUAL FIELD CONDITIONS, AND ARE ANTICIPATED TO RANGE FROM 10 FT. TO 13 FT. BELOW THE PROPOSED FINAL GRADE. FINAL WELL DEPTHS AND LOCATIONS SHALL BE ESTABLISHED, BY THE REMEDIAL DESIGNER, IN THE FIELD.
- 2.) SLOTS SHALL BE CUT PERPENDICULAR TO PIPE AXIS, (4) PER ROW. EACH ROW TO BE INDEXED 45°. SLOT LENGTHS ARE DETERMINED FROM PIPE INSIDE DIAMETER. CONTRACTOR MAY SUBMIT ALTERNATE SLOTTED WELL CASING DETAILS AND/OR MANUFACTURED PRODUCTS FOR FAVORABLE REVIEW BY THE REMEDIAL DESIGNER.
- 3.) SEE FIGURE 12 FOR ADDITIONAL INFORMATION RELATED TO THE SPECIFIED GROUNDWATER PUMPING SYSTEM CONTROL SYSTEMS.
- 4.) PUMP VENT LINES SHALL NOT BE ALLOWED TO BECOME SUBMERGED.
- 5.) ALL CARRIER PIPES SHALL BE HDPE SDR-17, OR APPROVED EQUAL. SEE FIGURE 9 FOR CARRIER PIPE SIZES.
- 6.) SECONDARY CARRIER PIPES SHALL PROVIDE A REDUNDANT MEANS TO FACILITATE FUTURE MAINTENANCE OF THE GROUNDWATER RECOVERY SYSTEM. ALL SECONDARY CARRIER PIPES SHALL BE CAPPED AT THEIR ENDS INSIDE BUILDING AND WITHIN THE NEW EXTRACTION WELL VAULTS.
- 7.) PRIMARY AND SECONDARY CARRIER PIPES SHALL ENTER VAULTS THROUGH APPROPRIATELY SIZED OPENING. THE PRIMARY CARRIER PIPE SHALL BE PHYSICALLY CONNECTED TO THE 12-INCH DIA. WELL CASING, AND THE SECONDARY CARRIER PIPE SHALL BE 6-INCH (MIN.) OFFSET FROM THE PRIMARY CARRIER PIPE. SECONDARY CARRIER PIPES SHALL BE CAPPED AT ALL ENDS IN THE VAULTS, AND SHALL PROTRUDE 6-INCH (MIN.) INSIDE THE INSIDE FACE OF THE VAULTS.

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PRE-FABRICATED BUILDING FLOOR PLAN

1
11



SECTION A-A'

NOT ALL FITTING/COMPONENTS/PIPE SHOWN FOR CLARITY PURPOSES


A
11

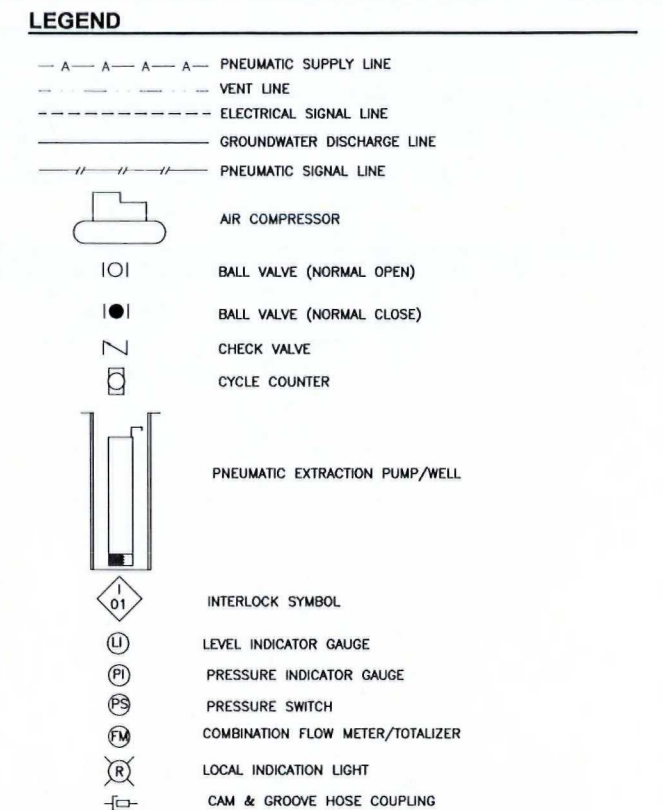
NOTES

- THE LAYOUT PRESENTED HEREIN IS INTENDED TO SHOW THE SPECIFIED SCOPE OF WORK INCLUDING, BUILDING REQUIREMENTS AND REQUIRED MINIMUM BUILDING SIZES. CONTRACTOR SHALL BE RESPONSIBLE FOR FINALIZING THE LAYOUT OF THE SPECIFIED PRE-ENGINEERED STRUCTURE, BASED ON ACTUAL EQUIPMENT SIZES AND ROUTING OF PIPING. THE FINAL LAYOUT, AS DEVELOPED BY CONTRACTOR SHALL BE SUBMITTED FOR FAVORABLE REVIEW, AND SHALL BE LOGICAL, PROVIDE FOR EASE OF MAINTENANCE AND OPERATION, AND MEET ALL APPLICABLE FEDERAL, STATE AND LOCAL RULES, CODES, AND REGULATIONS.
- CONTRACTOR SHALL DESIGN AND INSTALL ALL UTILITIES INCLUDING PIPING, ELECTRICAL, HVAC, LIGHTING, FOUNDATIONS, STRUCTURAL SUPPORTS, AND OTHER APPURTENANCES DEVICES NECESSARY TO MEETS THE REQUIREMENTS SET FORTH IN THE TECHNICAL SPECIFICATIONS.
- CONTRACTOR SHALL INSTALL THE CONCRETE FOUNDATIONS FOR THE PRE-ENGINEERED BUILDINGS AND ABOVEGROUND STORAGE TANK (AST) FOUNDATION, INCLUDING COLUMN FOOTINGS, GRADE BEAMS, CURBS, AND ALL EXTERIOR CONCRETE WORK ASSOCIATED WITH THE BUILDINGS.
- CONTRACTOR SHALL SAW-CUT EXISTING FLOOR SLAB, AS NECESSARY, TO INSTALL NEW FOUNDATION SYSTEMS AND PIPE/CONDUIT PENETRATIONS. FLOOR SLAB SHALL BE REPLACED/REPAIRED, AS REQUIRED, TO MAINTAIN ORIGINAL SLAB ELEVATION.
- BUILDING SHALL BE HEATED TO MAINTAIN INTERIOR TEMPERATURE OF 55 °F (MIN.).
- BUILDING SHALL BE PROVIDED WITH EITHER A RIDGE VENT OR GABLE-END VENTS.
- BUILDING SHALL BE PROVIDED WITH AN EXHAUST FAN AND INLET LOUVER TO PROVIDE MINIMUM 1100 CFM AT 0.25" STATIC PRESSURE. FAN AND LOUVER SHALL BE LOCATED OPPOSITE EACH OTHER TO PROVIDE CROSS VENTILATION.
- ALL EXHAUST VENTS SHALL TERMINATE ABOVE ROOF LINE.
- LAVATORY SHALL BE EQUIPPED WITH A FAN, WHICH VENTS TO THE EXTERIOR.
- CONTRACTOR SHALL DESIGN THE SPECIFIED PRE-ENGINEERED METAL BUILDING SUCH THAT THE HOLDING TANK INVERT AND ALL MECHANICAL EQUIPMENT (i.e., COMPRESSORS, LEAK DETECTION PANEL, AND TFSO CONTROL PANEL) ARE AT OR ABOVE ELEVATION EL. +8.0 FEET.
- CONTRACTOR MAY ELECT TO DEMOLISH THE EXISTING BUILDING FOUNDATION SLABS IN ITS ENTIRETY. IF CONTRACTOR DEMOLISHES THE EXISTING FLOOR SLABS, IT SHALL REMOVE ALL ASSOCIATED PERIMETER WALL AND INTERIOR COLUMN SPREAD FOOTINGS, BACKFILL WITH STRUCTURAL BACKFILL, AND CONSTRUCT NEW FOUNDATIONS FOR THE SPECIFIED PRE-ENGINEERED METAL STRUCTURE.
- CONTRACTOR SHALL DESIGN AND CONSTRUCT CONTAINMENT BARRIERS/WALLS OUTSIDE THE BUILDING AND AT THE TANKER TRUCK CONNECTION POINT. CONTAINMENT VOLUME SHALL BE 5,000 GALLONS (MIN.) ACTUAL LOCATION, DIMENSIONS, AND SIZE OF CONTAINMENT AREAS SHALL BE ESTABLISHED BY CONTRACTOR, AND SUBMITTED FOR FAVORABLE APPROVAL BY THE REMEDIAL DESIGNER.


REFERENCE

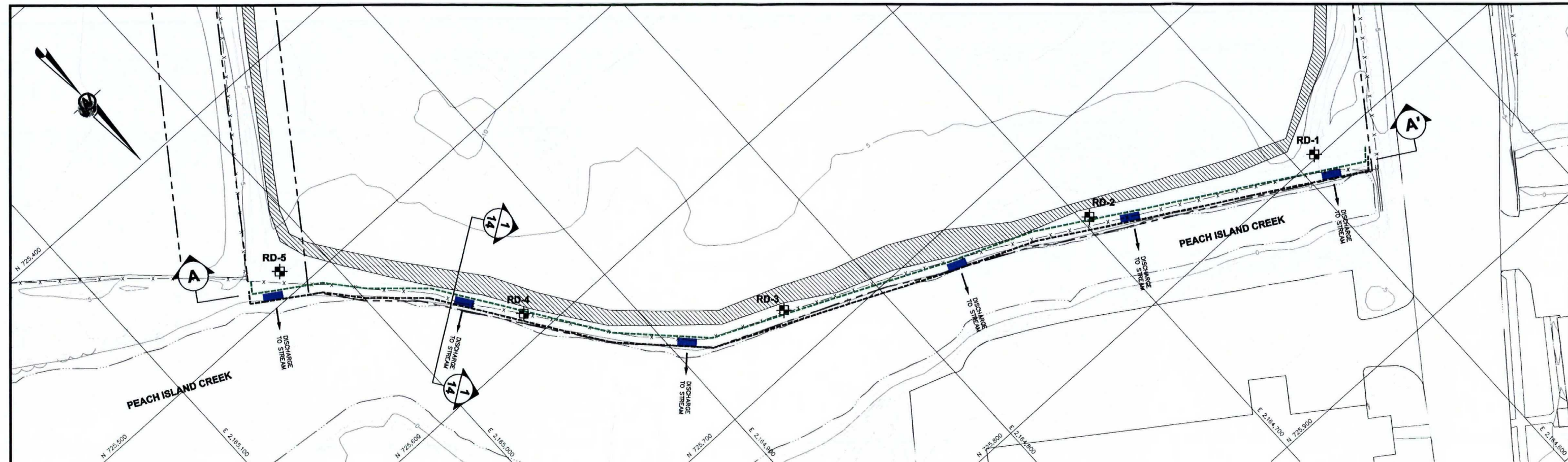
- VERTICAL DATUM REFERENCES THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

REV	DATE	DES	REVISION DESCRIPTION				CADD	CHK	RVM
PROJECT									
216 PATERSON PLANK ROAD SITE FINAL DESIGN REPORT FOR OU-2 CARLSTADT, BERGEN COUNTY, NEW JERSEY									
TITLE									
GROUNDWATER RECOVERY SYSTEM DETAILS (SHEET 2 OF 2)									
			NJ Authorization #24CA2802900		PROJECT No. 943-8222		FILE No. 94382220011		
DESIGN		KGK	05/07/07		SCALE		N.T.S. REV. 0		
CADD		YPW	05/07/07						
CHECK		KGK	05/07/07						
REVIEW		MFM	05/07/07						
							FIGURE 11		

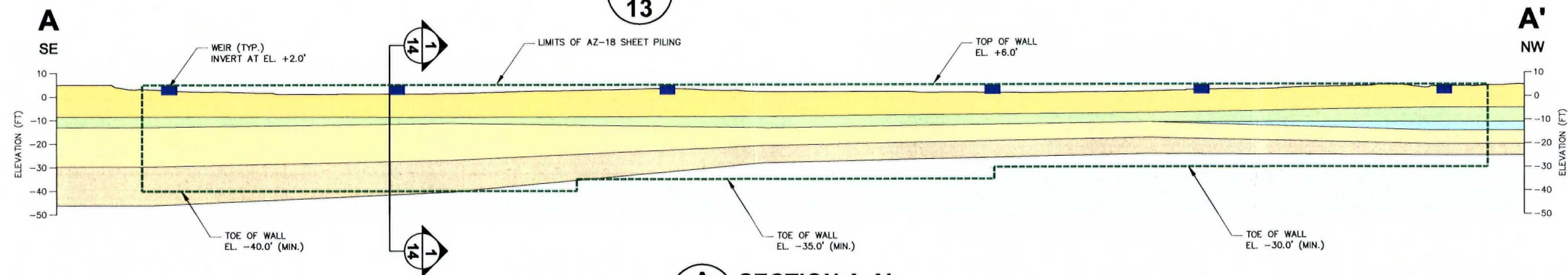


- 1.) COMPRESSED AIR SUPPLY LINE AND GROUNDWATER DISCHARGE LINES TO BE INSTALLED WITHIN CARRIER PIPES, AS INDICATED ON FIGURE 9. CARRIER PIPES TO PROVIDE SECONDARY CONTAINMENT OF DISCHARGE LINES, AND SHALL BE CONTINUOUS BETWEEN WELLS AND THE STORAGE TANK INLET CONNECTION. CARRIER PIPES DIAMETERS VARY (SEE FIGURE 9 FOR SIZES). SEAL ENDS OF SECONDARY CARRIER PIPES AT TANK CONNECTION AND EACH VAULT.
- 2.) GROUNDWATER STORAGE TANK SHALL BE FURNISHED WITH #4" NPT FITTINGS/CONNECTIONS UNLESS NOTED OTHERWISE.
- 3.) THE RUN OF HOSES BETWEEN EXTRACTION WELLS SHALL BE CONTINUOUS (I.E. NO SPLICES PERMITTED).
- 4.) INTERLOCK SCHEDULE:
 - 01-STORAGE TANK'S "FULL TANK" ALARM PROVIDE SIGNAL TO THE QED TSFO CONTROL BOX TO SHUTOFF THE PNEUMATIC AIR SUPPLY TO EXTRACTION PUMPS.
 - 02-STORAGE TANK LEAK DETECTION WILL LIGHT LOCAL LED AND SHUT COMPRESSOR OFF IF LIQUID IS DETECTED.
 - 03-TANK LEVEL SWITCH SHALL ALARM AND TURN COMPRESSOR OFF WHEN TANK REACHES "HIGH-HIGH" LEVEL CONDITION.
- 5.) MINIMUM SIZE OF TRANSFER HOSE SHALL BE #3", 100 FEET MAXIMUM. CAM AND GROOVE FITTING TO MATCH TANKER TRUCK.
- 6.) GROUNDWATER EXTRACTION PUMPS ARE PNEUMATICALLY OPERATED. THE PRINCIPAL OF OPERATION IS AS FOLLOWS: FLUIDS ENTERS THE PUMP VIA A SCREENED BOTTOM INLET PORT. THE FLUID LEVEL RISES IN THE BODY OF THE PUMP WHERE AIR INSIDE THE PUMP IS DISPLACED AND VENTS THROUGH THE EXHAUST AIR VALVE. AN INTERNAL FLOAT WILL RISE TO THE TOP OF ITS STROKE UPON REACHING THE UPPER POSITION, THE FLOAT TRIGGERS A LEVER ASSEMBLY WHICH CLOSSES THE AIR EXHAUST VALVE AND OPENS THE COMPRESSED AIR INLET. OPENING THE COMPRESSED AIR VALVE WILL PRESSURIZE THE PUMP'S CHAMBER AND FORCE THE COLLECTED LIQUID OUT TO THE STORAGE TANK, AS THE FLUID LEVEL FALLS, THE INTERNAL FLOAT MOVES DOWN TO THE BOTTOM OF ITS STROKE WHERE IT TRIGGERS THE LEVER ASSEMBLY TO CLOSE THE COMPRESSED AIR SUPPLY AND OPENS THE AIR EXHAUST VALVE ALLOWING ANOTHER CYCLE TO RESUME.
- 7.) SEE SECTIONS 11110 AND 11372 OF THE TECHNICAL SPECIFICATIONS FOR ADDITIONAL DETAILS AND INFORMATION WITH RESPECT TO THE SPECIFIED PNEUMATIC PUMPS AND AIR COMPRESSORS.
- 8.) TANK LEVEL 2 FLOAT SENSOR SHALL ACTIVATE LOCAL LIGHT WHEN TANK REACHES "HIGH" LEVEL THE SENSOR SHALL ALARM AND SHUT COMPRESSOR OFF WHEN TANK REACHES "HIGH-HIGH" LEVEL.
- 9.) THE AUTO-DIALER SHALL NOTIFY WHEN ANY OF THE FOLLOWING CONDITIONS ARE REALIZED: LIQUID DETECTED IN THE TANK'S INTERSTITIAL SPACE (SECONDARY CONTAINMENT); A "HIGH-HIGH" LEVEL IS REACHED; AND/OR "LOW" PRESSURE IN THE COMPRESSED AIR SUPPLY SYSTEM. THE AIR COMPRESSOR SHALL SHUTDOWN AS NOTED IN INTERLOCK SCHEDULE 02 AND 03.

REV	DATE	DES	REVISION	DESCRIPTION	CADD	CHK	RV
PROJECT			216 PATERSON PLANK ROAD SITE FINAL DESIGN REPORT FOR OU-2 CARLSTADT, BERGEN COUNTY, NEW JERSEY				
TITLE GROUNDWATER RECOVERY SYSTEM PROCESS FLOW DIAGRAM AND EQUIPMENT LIST							
 Golder Associates Philadelphia, USA			NJ Authorization #24GA28029100		PROJECT No. 943-6222 DESIGN TLC 05/07/07 CADD TLC 05/07/07 CHECK KGK 05/07/07 REVIEW MFM 05/07/07		
			FILE No. 943622200 SCALE N.T.S. REV.		FIGURE 12		



1
13 SHEET PILE WALL PLAN



A
13 SECTION A-A'

LEGEND

— 5 —	EXISTING GROUND CONTOURS	FILL
— x — x — x —	EDGE OF STREAM	PEAT
— x — x — x —	EXISTING FENCE	ORGANIC SILT/CLAY
— — — — —	PROPERTY LINE	UPPER VARVED CLAY
— — — — —	EXISTING SLURRY WALL	LOWER VARVED CLAY
— — — — —	EXISTING SHEET PILE WALL (TO BE PARTIALLY REMOVED)	GLACIAL TILL
— — — — —	NEW SHEET PILE WALL	
RD-1	PRE-DESIGN INVESTIGATION BORINGS	
■	WEIR (SEE DETAIL 2/14)	

NOTES

- 1.) ALL LOCATIONS ARE APPROXIMATE.
- 2.) THE SUBSURFACE PROFILE SHOWN HEREIN IS FOR ILLUSTRATIVE PURPOSES ONLY, AND SHOULD NOT BE MISCONSTRUED TO REPRESENT CONDITIONS ANTICIPATED DURING CONSTRUCTION. CONTRACTOR SHALL USE ALL AVAILABLE SUBSURFACE INFORMATION TO ESTABLISH ITS OWN SITE-SPECIFIC INTERPRETATIONS OF THE UNDERLYING GEOLOGIC CONDITIONS ALONG THE ALIGNMENT OF THE NEW SHEET PILE WALL.
- 3.) IF CONTRACTOR ENCOUNTERED DEBRIS AND/OR OBSTRUCTIONS WITHIN THE EXISTING FILL, CONTRACTOR SHALL EXCAVATE SAID OBSTRUCTIONS AT ITS OWN COST, AND CONTINUE TO INSTALL THE SPECIFIED SHEET PILE WALL, AS SPECIFIED.
- 4.) SEE FIGURE 14 FOR TYPICAL SHEET PILE WALL DETAILS.
- 5.) SEE SECTION 02460 OF TECHNICAL SPECIFICATIONS FOR ADDITIONAL DETAILS AND REQUIREMENTS WITH RESPECT TO THE SPECIFIED SHEET PILE WALL OPERATIONS.
- 6.) ALL INSTALLED SHEET PILE SECTIONS SHALL BY AZ-18 STEEL SECTIONS, AS MANUFACTURED BY SKYLINE STEEL, OR APPROVED EQUIVALENT.

REFERENCES

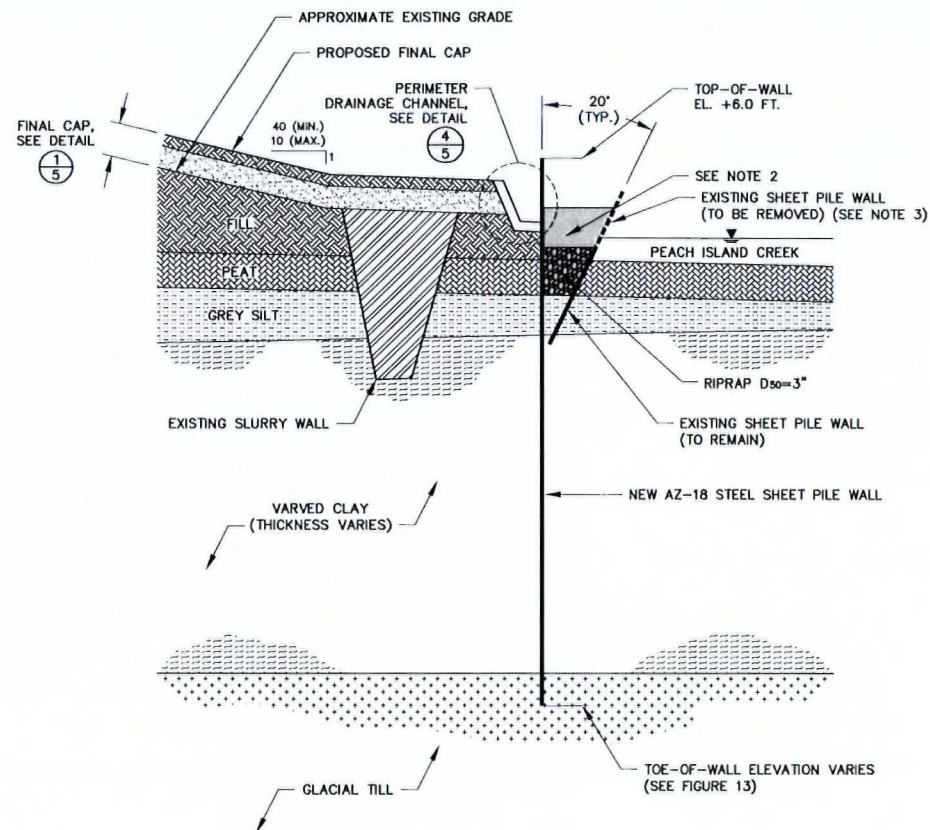
- 1.) BASE MAP SHOWN TAKEN FROM DIGITAL FILE 3074-02-TOP0.DWG, ENTITLED "BOROUGH OF CARLSTADT BLOCK 124 LOTS 1 THROUGH 5," DATED DECEMBER 8, 2005, PREPARED BY PROMAPS.
- 2.) HORIZONTAL DATUM REFERENCES THE NEW JERSEY STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83). VERTICAL DATUM REFERENCES THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

25 0 25 50
SCALE FEET

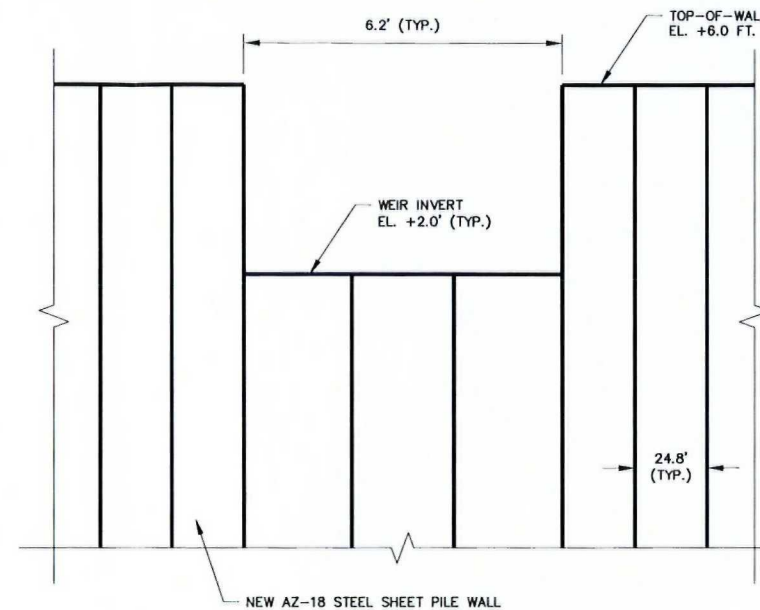
REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
PROJECT						
216 PATERSON PLANK ROAD SITE FINAL DESIGN REPORT FOR OU-2 CARLSTADT, BERGEN COUNTY, NEW JERSEY						
TITLE						
SHEET PILE WALL PLAN AND SECTION						
No Authorization #24528029100						
PROJECT No.			943-6222	FILE No.		
DESIGN			VEF 05/07/07	SCALE		
CADD			RG 05/07/07	AS SHOWN		
CHECK			DKL 05/07/07	REV.		
REVIEW			MFM 05/07/07	0		



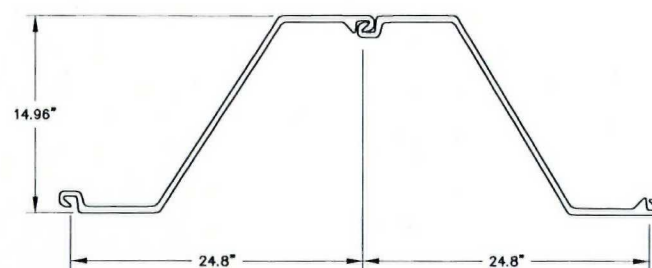
FIGURE 13



1
14 **TYPICAL SHEET PILE WALL DETAIL**
NOT TO SCALE



2
14 **TYPICAL WEIR DISCHARGE TO STREAM DETAIL**
NOT TO SCALE



3
14 **TYPICAL AZ-18 SHEET PILE DETAIL**
NOT TO SCALE

NOTES

- 1.) ALL LOCATIONS ARE APPROXIMATE.
- 2.) PRIOR TO REMOVAL OF THE UPPERMOST PORTION OF THE EXISTING SHEET PILE WALL, REMOVE MATERIALS BETWEEN EXISTING AND NEW WALLS TO ABOUT EL. -2.0 FT., OR AS DIRECTED BY THE REMEDIAL ENGINEER, AND BACKFILL WITH RIPRAP TO ABOUT EL. -1.0 FT., OR AS DIRECTED BY THE REMEDIAL ENGINEER.
- 3.) THE UPPERMOST PORTION OF THE EXISTING SHEET PILE WALL SHALL BE REMOVED BY CUTTING THE WALL ALONG THE PEACH ISLAND CREEK LOW WATER LEVEL (I.E. ABOUT EL. -1.0 FT.), OR AS DIRECTED BY THE REMEDIAL ENGINEER.
- 4.) SEE SECTION 02460 OF THE TECHNICAL SPECIFICATIONS FOR ADDITIONAL DETAILS AND REQUIREMENTS WITH RESPECT TO THE PROPOSED STEEL SHEET PILE OPERATIONS.
- 5.) SEE FIGURES 4 AND 13 FOR APPROXIMATE LOCATIONS OF THE SPECIFIED WEIR DISCHARGE POINTS TO PEACH ISLAND CREEK.
- 6.) CONTRACTOR SHALL DEVELOP, PREPARE, AND SUBMIT, AS PART OF ITS REQUISITE SHOP DRAWINGS, INSTALLATION DETAILS FOR THE SPECIFIED NEW SHEET PILE WALL.

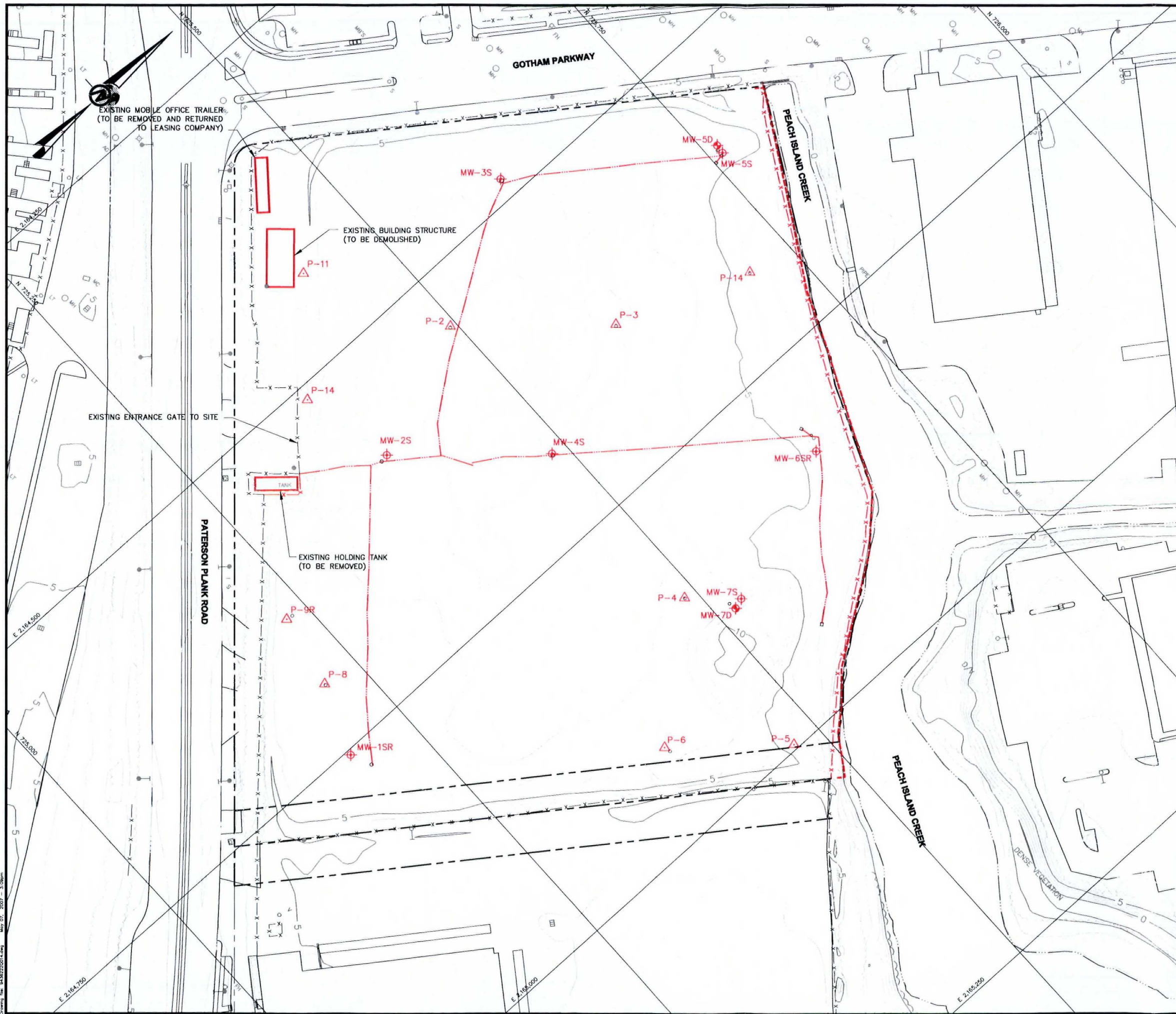
REFERENCE

- 1.) VERTICAL DATUM REFERENCES THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
PROJECT						
216 PATERSON PLANK ROAD SITE FINAL DESIGN REPORT FOR OU-2 CARLSTADT, BERGEN COUNTY, NEW JERSEY						
TITLE						
SHEET PILE WALL DETAIL						
PROJECT No. 943-6222			FILE No. 9436222Q008			
DESIGN	VEF	05/07/07	SCALE	AS SHOWN	REV.	0
CADD	RG	05/07/07				
CHECK	DKL	05/07/07				
REVIEW	MMF	05/07/07				



FIGURE 14



LEGEND

- EXISTING GROUND CONTOURS
- EDGE OF STREAM
- EXISTING FENCE (TO REMAIN)
- EXISTING FENCE (TO BE REMOVED)
- PROPERTY LINE
- EXISTING SHEET PILE WALL (TO BE PARTIALLY REMOVED)
- EXISTING GROUNDWATER EXTRACTION SYSTEM DISCHARGE HEADERS (TO BE REMOVED)
- EXISTING BUILDINGS/STRUCTURES (TO BE REMOVED/DEMOLISHED)
- MW-4S EXISTING GROUNDWATER EXTRACTION WELLS (TO BE DECOMMISSIONED)
- MW-5D EXISTING GROUNDWATER MONITORING WELLS (TO BE DECOMMISSIONED)
- P-4 EXISTING PIEZOMETERS (TO BE DECOMMISSIONED)

- NOTES**
- 1.) ALL LOCATIONS ARE APPROXIMATE.
 - 2.) CONTRACTOR MAY ELECT TO REMOVE PORTIONS OF THE EXISTING PERIMETER FENCE DURING CONSTRUCTION TO ACCOMMODATE ITS ACTIVITIES AND CONTRACTOR SHALL PROVIDE TEMPORARY ACCESS RESTRICTIONS IN AREAS WHERE THE EXISTING FENCE IS REMOVED. ALL REMOVED SECTIONS OF EXISTING FENCE SHALL BE RESTORED TO ITS ORIGINAL CONDITION, OR BETTER, UPON COMPLETION OF CONSTRUCTION.
 - 3.) CONTRACTOR SHALL PROTECT ALL STRUCTURES, FENCELINES, WELLS, AND OTHER SITE FEATURES DURING CONSTRUCTION, UNLESS INDICATED OTHERWISE ON THESE DRAWINGS, OR AS DIRECTED BY THE GROUP'S REPRESENTATIVE. CONTRACTOR SHALL REPLACE ANY DAMAGED ITEMS AT ITS SOLE EXPENSE.
 - 4.) SEE SECTION 02060 OF THE TECHNICAL SPECIFICATIONS FOR ADDITIONAL DETAILS AND REQUIREMENTS WITH RESPECT TO THE SPECIFIED DEMOLITION OPERATIONS.
 - 5.) THE EXISTING MOBILE OFFICE TRAILER SHALL BE REMOVED FROM SITE, AND RETURNED TO ITS ASSOCIATED LEASING COMPANY.

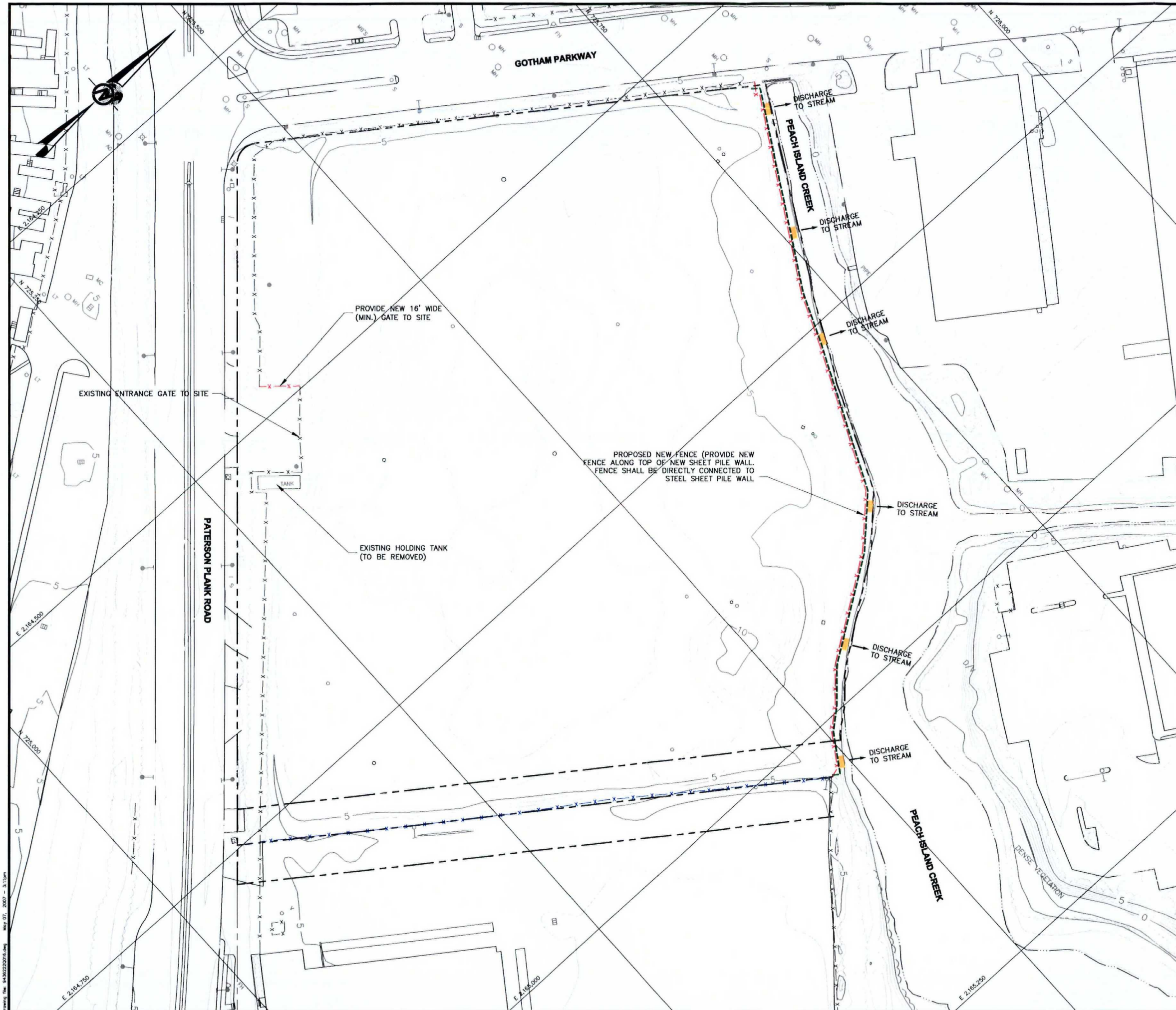
- REFERENCES**
- 1.) BASE MAP SHOWN TAKEN FROM DIGITAL FILE 3074-02-TOPO.DWG, ENTITLED "BOROUGH OF CARLSTADT BLOCK 124 LOTS 1 THROUGH 5," DATED DECEMBER 8, 2005, PREPARED BY PROMAPS.
 - 2.) HORIZONTAL DATUM REFERENCES THE NEW JERSEY STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83). VERTICAL DATUM REFERENCES THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).



REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
PROJECT						
216 PATERSON PLANK ROAD SITE FINAL DESIGN REPORT FOR OU-2 CARLSTADT, BERGEN COUNTY, NEW JERSEY						
TITLE						
DEMOLITION PLAN						
NJ Authorization #242A28029100						
PROJECT No.		943-6222		FILE No.		9436222Q014
DESIGN	VEF	05/07/07	SCALE	AS SHOWN	REV.	0
CADD	RG	05/07/07				
CHECK	MFM	05/07/07				
REVIEW	RJ	05/07/07				

Goldier Associates
Philadelphia USA

FIGURE 15



LEGEND

- EXISTING GROUND CONTOURS
- EDGE OF STREAM
- EXISTING FENCE
- NEW FENCE (SEE NOTE 3)
- FENCE (TO BE RESTORED, AS NECESSARY)
- PROPERTY LINE
- NEW SHEET PILE WALL (SEE NOTE 3)
- WEIR (SEE DETAIL 2/14)

NOTES

- ALL LOCATIONS APPROXIMATE.
- CONTRACTOR SHALL DEVELOP, PREPARE, AND SUBMIT, AS PART OF ITS REQUISITE SHOP DRAWINGS, TYPICAL FENCE AND GATE DETAILS, AS SPECIFIED BY THE CONTRACT.
- CONTRACTOR SHALL INSTALL NEW FENCES ALONG THE TOPS OF THE NEW SHEET PILE WALL. THIS FENCE SHALL BE PHYSICALLY ATTACHED/SECURED TO THE INSTALLED SHEET PILES, AND CONTRACTOR SHALL DEVELOP, PREPARE, AND SUBMIT CORRESPONDING DETAILS SHOWING HOW THE FENCE WILL BE ATTACHED/SECURED TO THE INSTALLED SHEET PILES.
- CONTRACTOR SHALL EXTEND THE FENCING VERTICALLY DOWNWARD AT EACH WEIR IN THE TOP OF THE INSTALLED SHEET PILE WALL, AND THESE DETAILS SHALL BE INCORPORATED INTO CONTRACTOR'S REQUISITE SHOP DRAWINGS.
- SEE SECTION 02831 OF THE TECHNICAL SPECIFICATIONS FOR ADDITIONAL DETAILS AND REQUIREMENTS WITH RESPECT TO THE SPECIFIED CHAIN LINK FENCE AND GATE INSTALLATION ACTIVITIES.
- CONTRACTOR MAY ELECT TO REMOVE PORTIONS OF THE EXISTING PERIMETER FENCE DURING CONSTRUCTION TO ACCOMMODATE ITS ACTIVITIES AND CONTRACTOR SHALL PROVIDE TEMPORARY ACCESS RESTRICTIONS IN AREAS WHERE THE EXISTING FENCE IS REMOVED. ALL REMOVED SECTIONS OF EXISTING FENCE SHALL BE RESTORED TO ITS ORIGINAL CONDITION, OR BETTER, UPON COMPLETION OF CONSTRUCTION.
- CONTRACTOR SHALL PROTECT ALL STRUCTURES, FENCELINES, WELLS, AND OTHER SITE FEATURES DURING CONSTRUCTION, UNLESS INDICATED OTHERWISE ON THESE DRAWINGS, OR AS DIRECTED BY THE GROUP'S REPRESENTATIVE. CONTRACTOR SHALL REPLACE ANY DAMAGED ITEMS AT ITS SOLE EXPENSE.

REFERENCES

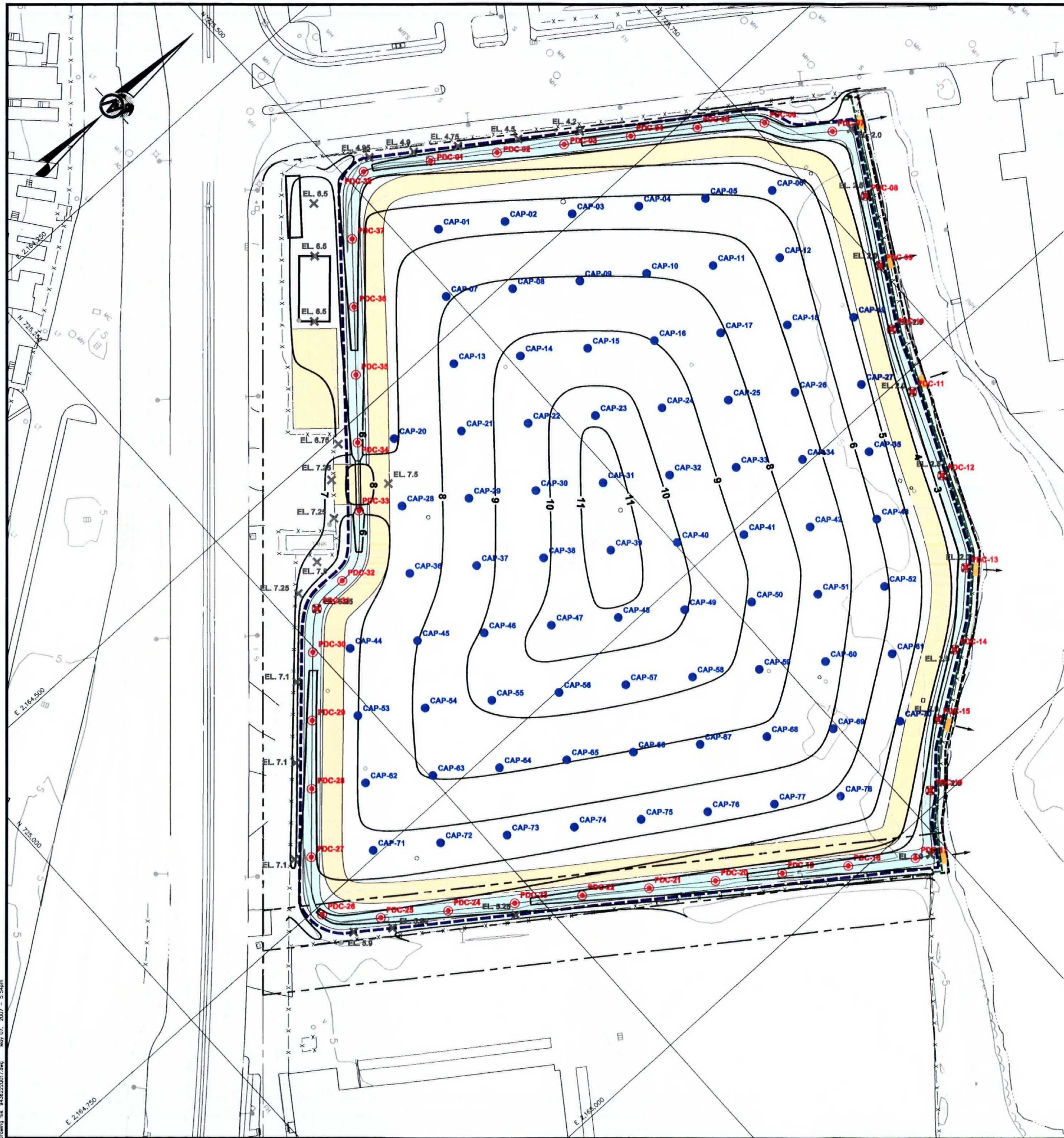
- BASE MAP SHOWN TAKEN FROM DIGITAL FILE 3074-02-TOPO.DWG, ENTITLED "BOROUGH OF CARLSTADT BLOCK 124 LOTS 1 THROUGH 5," DATED DECEMBER 8, 2005, PREPARED BY PROMAPS.
- HORIZONTAL DATUM REFERENCES THE NEW JERSEY STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83). VERTICAL DATUM REFERENCES THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).



REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
PROJECT						
216 PATERSON PLANK ROAD SITE FINAL DESIGN REPORT FOR OU-2 CARLSTADT, BERGEN COUNTY, NEW JERSEY						
TITLE						
FENCE RESTORATION PLAN						
NJ Authorization #24GA28029100						
PROJECT No.			943-6222	FILE No.		
DESIGN			VEF 05/07/07	SCALE		
CADD			RG 05/07/07	AS SHOWN		
CHECK			MFM 05/07/07	REV.		
REVIEW			RJI 05/07/07	0		



FIGURE 17



ID	EASTING	NORTHING	ELEVATION
CAP-01	2164437.30	725525.05	6.66
CAP-02	2164466.32	725565.76	6.62
CAP-03	2164495.35	725606.47	6.49
CAP-04	2164524.38	725647.18	6.31
CAP-05	2164553.41	725687.89	6.10
CAP-06	2164582.43	725728.60	5.82
CAP-07	2164611.46	725769.31	5.54
CAP-08	2164640.48	725810.02	5.26
CAP-09	2164669.51	725850.73	4.98
CAP-10	2164698.53	725891.44	4.70
CAP-11	2164727.56	725932.15	4.42
CAP-12	2164756.58	725972.86	4.14
CAP-13	2164785.61	726013.57	3.86
CAP-14	2164814.63	726054.28	3.58
CAP-15	2164843.66	726094.99	3.30
CAP-16	2164872.68	726135.70	3.02
CAP-17	2164901.71	726176.41	2.74
CAP-18	2164930.73	726217.12	2.46
CAP-19	2164959.76	726257.83	2.18
CAP-20	2164988.78	726298.54	1.90
CAP-21	2165017.81	726339.25	1.62
CAP-22	2165046.83	726379.96	1.34
CAP-23	2165075.86	726420.67	1.06
CAP-24	2165104.88	726461.38	0.78
CAP-25	2165133.91	726502.09	0.50
CAP-26	2165162.93	726542.80	0.22
CAP-27	2165191.96	726583.51	-0.06
CAP-28	2165220.98	726624.22	-0.34
CAP-29	2165249.01	726664.93	-0.62
CAP-30	2165278.03	726705.64	-0.90
CAP-31	2165307.06	726746.35	-1.18
CAP-32	2165336.08	726787.06	-1.46
CAP-33	2165365.11	726827.77	-1.74
CAP-34	2165394.13	726868.48	-2.02
CAP-35	2165423.16	726909.19	-2.30
CAP-36	2165452.18	726949.90	-2.58
CAP-37	2165481.21	726990.61	-2.86
CAP-38	2165510.23	727031.32	-3.14
PDC-01	2164396.05	725544.45	3.72
PDC-02	2164424.75	725595.40	3.40
PDC-03	2164453.40	725646.35	3.08
PDC-04	2164481.99	725697.30	2.76
PDC-05	2164510.51	725748.25	2.44
PDC-06	2164539.02	725799.20	2.12
PDC-07	2164567.54	725850.15	1.80
PDC-08	2164596.05	725901.10	1.48
PDC-09	2164624.57	725952.05	1.16
PDC-10	2164653.08	726003.00	0.84
PDC-11	2164681.60	726053.95	0.52
PDC-12	2164710.11	726104.90	0.20
PDC-13	2164738.63	726155.85	-0.12
PDC-14	2164767.14	726206.80	-0.40
PDC-15	2164795.66	726257.75	-0.68
PDC-16	2164824.17	726308.70	-0.96
PDC-17	2164852.69	726359.65	-1.24
PDC-18	2164881.20	726410.60	-1.52
PDC-19	2164909.72	726461.55	-1.80
PDC-20	2164938.23	726512.50	-2.08
PDC-21	2164966.75	726563.45	-2.36
PDC-22	2164995.26	726614.40	-2.64
PDC-23	2165023.78	726665.35	-2.92
PDC-24	2165052.29	726716.30	-3.20
PDC-25	2165080.81	726767.25	-3.48
PDC-26	2165109.32	726818.20	-3.76
PDC-27	2165137.84	726869.15	-4.04
PDC-28	2165166.35	726920.10	-4.32
PDC-29	2165194.87	726971.05	-4.60
PDC-30	2165223.38	727022.00	-4.88
PDC-31	2165251.90	727072.95	-5.16
PDC-32	2165280.41	727123.90	-5.44
PDC-33	2165308.93	727174.85	-5.72
PDC-34	2165337.44	727225.80	-6.00
PDC-35	2165365.96	727276.75	-6.28
PDC-36	2165394.47	727327.70	-6.56
PDC-37	2165423.00	727378.65	-6.84
PDC-38	2165451.51	727429.60	-7.12

LEGEND

- EXISTING GROUND CONTOURS
- EDGE OF STREAM
- EXISTING FENCE
- PROPERTY LINE
- EXISTING SHEET PILE WALL (TO BE PARTIALLY REMOVED)
- NEW SHEET PILE WALL (SEE FIGURES 13 AND 14)
- WEIR (SEE NOTE 5)
- SPOT ELEVATION
- PERIMETER DRAINAGE CHANNEL SURVEY CONTROL POINT
- COVER SURVEY CONTROL POINT
- LIMITS OF NEW GEOMEMBRANE (SEE NOTE 3)
- PROPOSED GROUND CONTOURS
- PERIMETER DRAINAGE CHANNEL (SEE DETAILS 2/5 AND 4/5)
- NEW PERIMETER ACCESS ROAD AND PARKING AREAS (SEE DETAILS 3/5 AND 5/5)

NOTES

- ALL LOCATIONS ARE APPROXIMATE.
- CONTRACTOR MAY ELECT TO REMOVE PORTIONS OF THE EXISTING PERIMETER FENCE DURING CONSTRUCTION TO ACCOMMODATE ITS ACTIVITIES AND CONTRACTOR SHALL PROVIDE TEMPORARY ACCESS RESTRICTIONS IN AREAS WHERE THE EXISTING FENCE IS REMOVED. ALL REMOVED SECTIONS OF EXISTING FENCE SHALL BE RESTORED TO ITS ORIGINAL CONDITION, OR BETTER, UPON COMPLETION OF CONSTRUCTION.
- LIMITS OF THE NEW GEOMEMBRANE SHALL COINCIDE WITH THE LIMITS OF THE EXISTING GEOMEMBRANE. ACTUAL LIMITS OF EXISTING GEOMEMBRANE ARE NOT KNOWN WITH CERTAINTY AND WILL BE FIELD VERIFIED.
- CONTRACTOR SHALL PROTECT ALL STRUCTURES, FENCELINES, WELLS, AND OTHER SITE FEATURES DURING CONSTRUCTION, UNLESS INDICATED OTHERWISE ON THESE DRAWINGS, OR AS DIRECTED BY THE GROUP'S REPRESENTATIVE. CONTRACTOR SHALL REPLACE ANY DAMAGED ITEMS AT ITS SOLE EXPENSE.
- SURFACE WATER FLOWS SHALL BE CONVEYED TO PEACH ISLAND CREEK VIA THE PERIMETER DRAINAGE CHANNELS, AND DISCHARGE TO CREEK THROUGH A SERIES OF WEIRS IN THE NEW SHEET PILE WALLS.
- LIMITS OF NEW GEOMEMBRANE AND PROPOSED CONTOURS MAY BE ADJUSTED IN THE FIELD TO ACCOUNT FOR ACTUAL FIELD CONDITIONS.
- SEE TABLE SHOWN HEREON FOR DESIGN NORTHINGS, EASTINGS, AND ELEVATIONS FOR ALL SURVEY CONTROL POINTS.
- ALL HORIZONTAL AND VERTICAL COORDINATES SHALL BE SURVEYED IN SAME SYSTEM IDENTIFIED HEREIN, AND CONTRACTOR SHALL SURVEY "AS-BUILT" CONDITIONS TO VERIFY ACTUAL FIELD CONDITIONS ACHIEVE THE DESIGN VALUES PRESENTED HEREIN.

REFERENCES

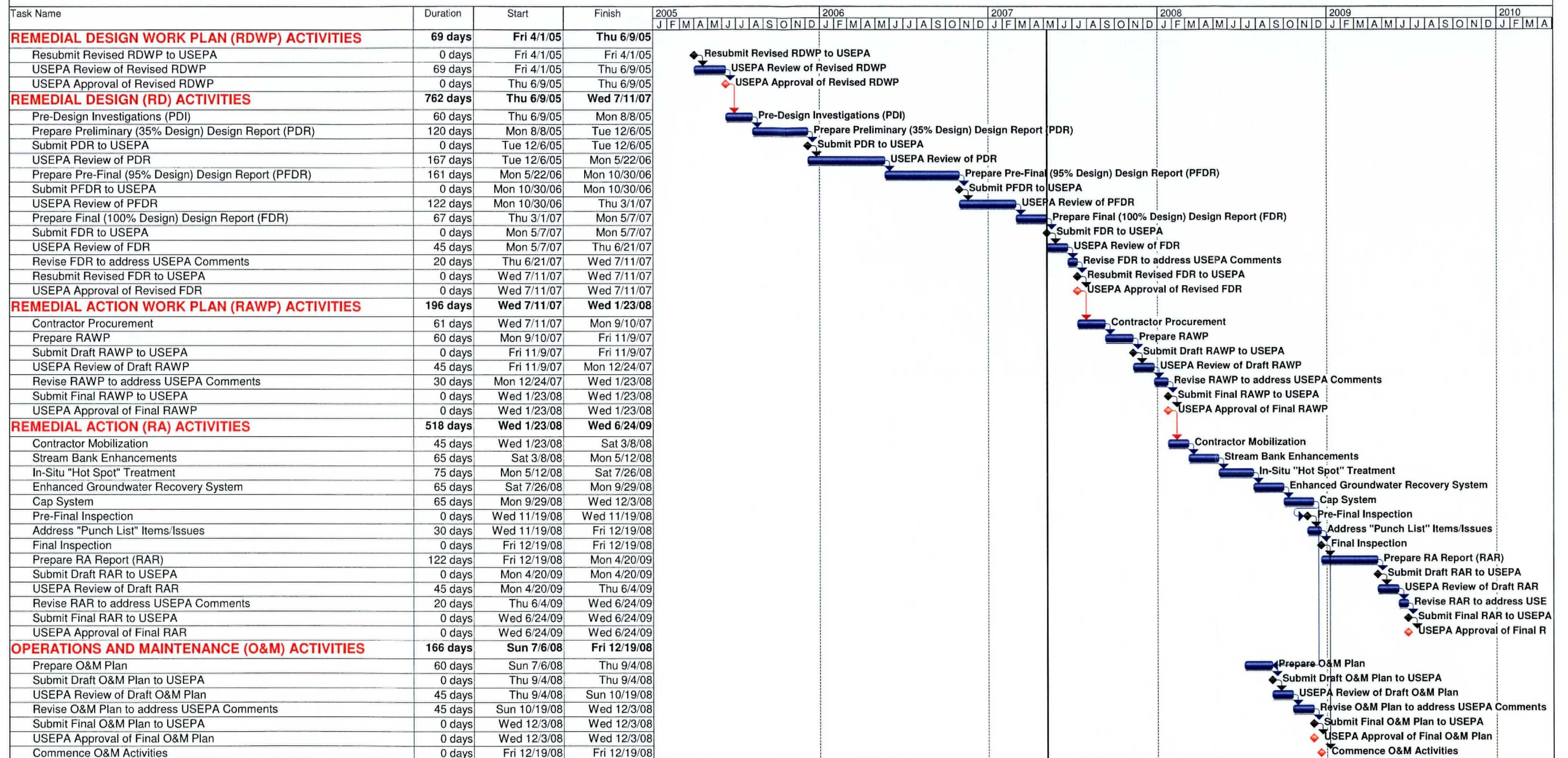
- BASE MAP SHOWN TAKEN FROM DIGITAL FILE 3074-02-TOPO.DWG, ENTITLED "BOROUGH OF CARLSTADT BLOCK 124 LOTS 1 THROUGH 5," DATED DECEMBER 8, 2005, PREPARED BY PROMAPS.
- HORIZONTAL DATUM REFERENCES THE NEW JERSEY STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83). VERTICAL DATUM REFERENCES THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).



REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
PROJECT						
216 PATERSON PLANK ROAD SITE FINAL DESIGN REPORT FOR OU-2 CARLSTADT, BERGEN COUNTY, NEW JERSEY						
TITLE						
SURVEY CONTROL PLAN						
NJ Authorization #24CA28029100						
PROJECT No.		943-6222		FILE No.		9436222Q017
DESIGN	MFM	05/07/07	SCALE	AS SHOWN	REV.	0
CADD	RG	05/07/07				
CHECK	MFM	05/07/07				
REVIEW	RJ	05/07/07				

FIGURE 18

Remedial Design / Remedial Action Schedule



Project: Operable Unit 2 (OU-2)
Date: May 7, 2007

Task Milestone

Actual schedule dates will be dependent on EPA's review time for each deliverable. RA schedule is dependent on required permit equivalences and approved contractor schedule. All field activities are dependent on weather conditions.



Figure 19
Remedial Design/Remedial Action Schedule
216 Paterson Plank Road Site

APPENDIX A

RD-SERIES BORING LOGS

RECORD OF BOREHOLE RD-1

PROJECT: 216 Paterson Plank Road
PROJECT NUMBER: 943-6222
DRILLED DEPTH: 34.0 ft
AZIMUTH: N/A
LOCATION: See Boring Location Plan

DRILL METHOD: Hollow-Stem Auger
DRILL RIG: Carterra CT 250
DATE STARTED: 9/13/05
DATE COMPLETED: 9/13/05
WEATHER: Sunny

DATUM:
COORDS: not surveyed
GS ELEVATION: 4.5 ft
TOC ELEVATION: N/A
TEMPERATURE: 88 degrees (F)

SHEET 1 of 1
INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE			SAMPLES							COMMENTS
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	PID (ppm)	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT	
0		0.0 - 4.0 Brown miscellaneous FILL, including silty sand, rock, wood and brick fragments										Description of FILL based on observed drill cuttings. Auger to 4.0 FT BGS without sampling, FILL
5	0	4.0 - 6.0 Black fibrous PEAT, with pieces of wood and brick fragments (FILL?)	PT		0.5 4.0	S1	SS	2.1	3-4-4	8	0.5 2.0	Wc = 24.07%
		6.0 - 8.0 Black fibrous PEAT with pieces of wood fragments and gravel (FILL?)	PT		-1.5 6.0	S2	SS	2.5	3-3-3	6	2.0 2.0	Wc = 27.57%
		8.0 - 10.0 Brown organic SILTY CLAY and PEAT, trace fine gravel	OL-ML		-3.5 8.0	ST-1	SH	3.5	PUSH	PUSH	0.3 2.0	Wc = 63.3%, LL = 85, PI = 38
10	-5	10.0 - 12.0 Brown SANDY CLAY with some fine gravel	CL-SM		-5.5 10.0	S3	SS	2.2	2-3-3	6	2.0 2.0	Wc = 14.3%
		12.0 - 14.0 Brown varved CLAY	CH		-7.5 12.0	S4	SS	1070	2-2-2	4	2.0 2.0	Wc = 43.17%, LL = 54, PI = 29
15	-10	14.0 - 16.0 Brown varved CLAY	CH		-9.5 14.0	ST-2	SH	163	PUSH	PUSH	2.0 2.0	Wc = 45.87%; Su = 568 psf, Cc = 0.4, Cv = 2 x 10 ⁻⁶ cm ² /sec
		16.0 - 18.0 Brown varved CLAY	CH		-11.5 16.0	S5	SS	19.2	2-2-2	4	2.0 2.0	Wc = 48.48%, LL = 52, PI = 29
		18.0 - 20.0 Brown varved CLAY	CH		-13.5 18.0	S6	SS	4.3	WOR-1-2	3	2.0 2.0	Wc = 44.9%
20	-15	20.0 - 21.0 Gray varved CLAY	CH		-15.5 20.0	S7	SS	1.6	1-2-2	4	2.0 2.0	Wc = 14.88%
		21.0 - 22.0 Reddish brown SANDY CLAY with trace fine gravel (GLACIAL TILL)	CL-SM		-16.5 21.0	S8	SS	0.7	2-3-16-6	19	2.0 2.0	Wc = 28.9%
		22.0 - 24.0 Brown CLAY with trace fine to coarse sand and fine gravel (GLACIAL TILL)	CL-SM		-17.5 22.0	S9	SS	1.3	2-2-3-2	5	2.0 2.0	Wc = 16.05%
25	-20	24.0 - 26.0 Reddish brown SANDY CLAY with trace fine gravel (GLACIAL TILL)	SW-SM		-19.5 24.0	S10	SS	1.0	2-2-3-4	5	2.0 2.0	Wc = 18.97%
		26.0 - 28.0 Reddish brown SANDY CLAY with trace fine gravel (GLACIAL TILL)	CL-SM		-21.5 26.0	S11	SS	0.9	2-3-2-2	5	2.0 2.0	Wc = 18.9%
		28.0 - 30.0 Brown CLAY with trace fine to coarse sand and fine gravel (GLACIAL TILL)	CL-SM		-23.5 28.0							
30	-25				-25.5 30.0							Auger to 33.0 FT BGS without sampling
		33.0 - 33.3 Reddish brown CLAY with trace to some fine to coarse sand and fine gravel (GLACIAL TILL)	CL-SM		-28.5 33.3	S12	SS	3.3	50/3"	50/3"	0.3 2.0	Boring terminated at 34.0 FT BGS at AUGER REFUSAL in GLACIAL TILL
		Boring completed at 34.0 ft										

AA GEOTECH LOG CARLSTADT RD BORINGS.GPJ GOLDER N.J.P.A.GDT 12/2/05

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: AmeriDrill, Inc
DRILLER: T. Brown

GA INSPECTOR: D.Gorman
CHECKED BY: M. McNeilly
DATE: 10/17/05



RECORD OF BOREHOLE RD-2

SHEET 1 of 1
INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

PROJECT: 216 Paterson Plank Road
PROJECT NUMBER: 943-6222
DRILLED DEPTH: 39.0 ft
AZIMUTH: N/A
LOCATION: See Boring Location Plan

DRILL METHOD: Hollow-Stem Auger
DRILL RIG: Canterra CT 250
DATE STARTED: 8/14/05
DATE COMPLETED: 8/14/15
WEATHER: Sunny

DATUM:
COORDS: not surveyed
GS ELEVATION: 4.0 ft
TOC ELEVATION: N/A
TEMPERATURE: 88 degrees (F)

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE			SAMPLES							COMMENTS
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	PID (ppm)	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC/ATT	
0		0.0 - 5.0 Gray miscellaneous FILL including sandy clay, gravel, concrete and brick fragments										Description of FILL based on observed drill cuttings. AUGER to 5.0 FT BGS without sampling, FILL.
5		5.0 - 7.0 Black fibrous PEAT	PT		-1.0 5.0	ST-1	SH	47.2	PUSH	PUSH	2.0 2.0	Wc = 35.5%; Cc = 0.38, Cv = 4 x 10 ⁻⁶ cm ² /sec
		7.0 - 9.0 Black fibrous PEAT to gray organic CLAY with interlayered fine sand	PT-OL		-3.0 7.0	ST-2	SH	10.7	PUSH	PUSH	2.0 2.0	
10		9.0 - 11.0 Gray varved CLAY	CH		-5.0 9.0	S1	SS	4.2	4-3-4-4	7	2.0 2.0	Wc = 41.94%, LL = 51, PI = 28
		11.0 - 13.0 Grayish brown varved CLAY	CH		-7.0 11.0	S2	SS	1.2	5-5-5-4	10	2.0 2.0	Wc = 43.1%
15		13.0 - 15.0 Grayish brown varved CLAY	CH		-9.0 13.0	ST-3	SH	4.4	PUSH	PUSH	2.0 2.0	Wc = 52.17%, Su = 217 psf
		15.0 - 17.0 Grayish brown varved CLAY	CH		-11.0 15.0	S3	SS	0.3	1-1-1-1	2	2.0 2.0	Wc = 45.53%, LL = 53, PI = 29
		17.0 - 18.0 Brown varved CLAY	CH		-13.0 17.0	S4	SS	N/A	2-3-4-4	7	2.0 2.0	Wc = 38.1%
20		18.0 - 19.0 Brown SANDY CLAY with trace fine gravel (GLACIAL TILL)	CL-SM		-14.0 18.0	ST-4	SH	10.8	PUSH	PUSH	1.0 2.0	Wc = 35.5%, LL = 36, PI = 17
		19.0 - 21.0 Reddish brown SANDY CLAY with little fine gravel (GLACIAL TILL)	CL-SM		-15.0 19.0							
		21.0 - 23.0 Brown CLAY with trace to little fine sand and gravel (GLACIAL TILL)	CL-SM		-17.0 21.0	S5	SS	0.5	4-5-7-7	12	2.0 2.0	Wc = 15.2%
25		23.0 - 25.0 Reddish brown SANDY CLAY with little fine gravel (GLACIAL TILL)	CL-SM		-19.0 23.0	S6	SS	0.9	4-3-8-15	11	2.0 2.0	Wc = 17.32%
					-21.0 25.0							AUGER to 28.0 FT BGS without sampling
30		28.0 - 30.0 Reddish brown SANDY CLAY with little fine sand and gravel (GLACIAL TILL)	CL-SM		-24.0 28.0	S7	SS	0.2	8-20-22-13	42	2.0 2.0	Wc = 14.45%
					-26.0 30.0							AUGER to 33.0 FT BGS without sampling
35		33.0 - 35.0 Brown CLAY and fine to medium sand with little fine gravel (GLACIAL TILL)	CL-SM		-29.0 33.0	S8	SS	0.1	8-9-7-15	16	2.0 2.0	Wc = 13.9%
					-31.0 35.0							AUGER to 38.0 FT BGS without sampling
40		38.0 - 38.3 Reddish brown SILTY CLAY with little fine gravel (GLACIAL TILL) Boring completed at 39.0 ft	CL-SM		-34.0 35.0	S9	SS	1.1	50/4*	50/4*	0.3 2.0	Boring terminated at 39.0 FT BGS at AUGER REFUSAL in GLACIAL TILL.

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: AmeriDrill, Inc
DRILLER: T. Brown

GA INSPECTOR: D.Gorman
CHECKED BY: M. McNeilly
DATE: 10/17/05



AA GEOTECH LOG CARLSTADT RD BORINGS.GPJ GOLDER N.J.PA.GDT 12/2/05

RECORD OF BOREHOLE RD-3

SHEET 1 of 2

PROJECT: 216 Paterson Plank Road
PROJECT NUMBER: 943-6222
DRILLED DEPTH: 42.0 ft
AZIMUTH: N/A
LOCATION: See Boring Location Plan

DRILL METHOD: Hollow-Stem Auger
DRILL RIG: Canterra CT 250
DATE STARTED: 9/15/05
DATE COMPLETED: 9/15/05
WEATHER: Rain/Overcast

DATUM:
COORDS: not surveyed
GS ELEVATION: 3.5 ft
TOC ELEVATION: N/A
TEMPERATURE: 85 degrees (F)

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE			SAMPLES							COMMENTS
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	PID (ppm)	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT	
0		0.0 - 2.0 Gray miscellaneous fill including sandy clay, gravel, brick and concrete fragments (FILL)			1.5							Description of FILL based on observed drill cuttings and split spoon sample. AUGER to 2.0 FT BGS without sampling, FILL
		2.0 - 4.0 Gray miscellaneous fill including sandy clay, gravel, brick and concrete fragments (FILL)			2.0	S1	SS	0.0	7-5-4-4	9	1.0 2.0	
0		4.0 - 6.0 Gray miscellaneous fill including sandy clay, gravel, brick and concrete fragments (FILL)			-0.5 4.0							
5		6.0 - 8.0 Black fibrous PEAT	PT		-2.5 6.0	ST-1	SH	22.9	PUSH	PUSH	1.0 2.0	AUGER to 6.0 FT BGS without sampling, FILL
		8.0 - 10.0 No Recovery			-4.5 8.0	ST-1a	SH	N/A	PUSH	PUSH	0.0 2.0	Wc = 50.34%
10		10.0 - 12.0 Black CLAYEY SAND to red brown varved CLAY	CL-SM		-6.5 10.0	S2	SS	15.9	9-8-8-9	18	2.0 2.0	Attempt Shelby Tube 8.0 to 10.0 FT BGS, resistance encountered at 8.0 FT BGS. Abort Shelby Tube attempt, no recovery.
		12.0 - 14.0 Reddish brown varved CLAY	CL		-8.5 12.0	S3	SS	7.6	3-3-3-2	6	2.0 2.0	Wc = 31.07%, LL = 36, PI = 18
-10		14.0 - 16.0 Gray varved CLAY	CL		-10.5 14.0	ST-2	SH	0.1	PUSH	PUSH	2.0 2.0	Wc = 37.80%
15		16.0 - 18.0 Brown varved CLAY	CH		-12.5 16.0	S4	SS	0.0	WOH-WOH	0	2.0 2.0	Wc = 38.78%, Su = 632 psf
		18.0 - 20.0 Gray varved CLAY	CH		-14.5 18.0	ST-3	SH	0.6	PUSH	PUSH	2.0 2.0	Wc = 54.0%, LL = 56, PI = 31
-15		20.0 - 21.0 Gray varved CLAY	CH		-16.5 20.0	S5	SS	0.0	WOR-WOR	0	2.0 2.0	Wc = 48.79%; Cc = 0.84, Cv = 5 x 10 ⁻⁶ cm ² /sec
20		21.0 - 22.0 Reddish brown SANDY CLAY with fine gravel (GLACIAL TILL)	CL-SM		-17.5 21.0	S6	SS	0.0	1-2-1-2	3	2.0 2.0	Wc = 39.15%
		22.0 - 24.0 Brown CLAY and fine to coarse sand with little fine gravel (GLACIAL TILL)	CL-SM		-18.5 22.0							Wc = 14.4%
-20					-20.5 24.0							AUGER to 28.0 FT BGS without sampling
25												
		28.0 - 30.0 Reddish brown SANDY CLAY with fine gravel (GLACIAL TILL)	CL-SM		-24.5 28.0	S7	SS	0.0	10-12-21-39	33	2.0 2.0	Wc = 20.18%
-25					-26.5 30.0							AUGER to 33.0 FT BGS without sampling
30												
		33.0 - 35.0 Brown CLAY and fine to coarse sand with some fine gravel (GLACIAL TILL)	CL-SM		-28.5 33.0	S8	SS	0.0	17-23-28-32	51	2.0 2.0	Wc = 14.9%
-30					-31.5 35.0							AUGER to 38.0 FT BGS without sampling
35												
		38.0 - 40.0 Reddish brown SANDY CLAY with fine gravel (GLACIAL TILL)	CL-SM		-34.5 38.0	S9	SS	0.0	13-17-35-50/5"	52	2.0 2.0	Wc = 8.93%
-35					-36.5							
40		Log continued on next page										

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: AmeriDrill, Inc
DRILLER: T. Brown

GA INSPECTOR: D.Gorman
CHECKED BY: M. McNelly
DATE: 10/17/05



RECORD OF BOREHOLE RD-3

SHEET 2 of 2

PROJECT: 216 Paterson Plank Road
PROJECT NUMBER: 943-8222
DRILLED DEPTH: 42.0 ft
AZIMUTH: N/A
LOCATION: See Boring Location Plan

DRILL METHOD: Hollow-Stem Auger
DRILL RIG: Canterra CT 250
DATE STARTED: 9/15/05
DATE COMPLETED: 9/15/05
WEATHER: Rain/Overcast

DATUM:
COORDS: not surveyed
GS ELEVATION: 3.5 ft
TOC ELEVATION: N/A
TEMPERATURE: 85 degrees (F)

INCLINATION: -80
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE				SAMPLES						COMMENTS
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	PID (ppm)	BLOWS per 6 in	N	REC / ATT	
					DEPTH (ft)				140 lb hammer 30 inch drop			
40					40.0							AUGER to 42.0 FT BGS without sampling
					-38.5							Boring terminated at 42.0 FT BGS at AUGER REFUSAL in GLACIAL TILL
		Boring completed at 42.0 ft										
-40												
45												
-45												
50												
-50												
55												
-55												
60												
-60												
65												
-65												
70												
-70												
75												
-75												
80												

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: AmeriDrill, Inc
DRILLER: T. Brown

GA INSPECTOR: D.Gorman
CHECKED BY: M. McNeilly
DATE: 10/17/05



AA GEOTECH LOG CARLSTADT RD BORINGS.GPJ GOLDER NJ-PA.GDT 12/2/05

RECORD OF BOREHOLE RD-4

SHEET 1 of 2

PROJECT: 216 Paterson Plank Road
PROJECT NUMBER: 943-6222
DRILLED DEPTH: 46.0 ft
AZIMUTH: N/A
LOCATION: See Boring Location Plan

DRILL METHOD: Hollow-Stem Auger
DRILL RIG: Canterra CT 250
DATE STARTED: 8/16/05
DATE COMPLETED: 9/16/05
WEATHER: Overcast

DATUM:
COORDS: not surveyed
GS ELEVATION: 4.0 ft
TOC ELEVATION: N/A
TEMPERATURE: 82 degrees (F)

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE			SAMPLES							COMMENTS
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	NUMBER	TYPE	PID (ppm)	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT	
0		0.0 - 4.0 Gray miscellaneous fill including clayey sand, gravel, brick and concrete fragments (FILL)			0.0							Description of FILL based on observed drill cuttings. AUGER to 4.0 FT BGS without sampling, FILL
5		4.0 - 6.0 Gray miscellaneous fill including green gray silty sand, clayey sand, gravel, brick and concrete fragments (FILL)			4.0	ST-1	SH	0.0	PUSH	PUSH	2.0 2.0	Wc = 20.79%
		6.0 - 8.0 Gray organic CLAY with interlayered fine sand	OL		6.0	ST-2	SH	1.2	PUSH	PUSH	2.0 2.0	Wc = 20.14%, Su = 770 psf
		8.0 - 9.0 Gray organic CLAY	OL		8.0							Wc = 30.65%
		9.0 - 10.0 Gray and brown varved CLAY	CL		9.0	S1	SS	0.0	WOH-S-4-6	9	2.0 2.0	
		10.0 - 12.0 Gray and brown varved CLAY	CL		10.0	S2	SS	419	8-8-7-7	15	2.0 2.0	Wc = 28.84%
		12.0 - 14.0 Gray varved CLAY	CL		12.0	ST-3	SH	0.0	PUSH	PUSH	2.0 2.0	Wc = 35.45%, Su = 707 psf, Cc = 0.32, Cv = 2.5 x 10 ⁻³ cm ² /sec
		14.0 - 16.0 Grayish brown varved CLAY	CL		14.0	S3	SS	7.6	WOH-WOH	0	2.0 2.0	Wc = 45.3%, LL = 48, PI = 25
		16.0 - 18.0 Gray varved CLAY	CL		16.0	S4	SS	6.1	1-1-1-1	2	2.0 2.0	Wc = 45.91%
		18.0 - 20.0 Gray varved CLAY	CL		18.0	ST-4	SH	152	PUSH	PUSH	2.0 2.0	Wc = 38.50%, Su = 120 psf
		20.0 - 22.0 Gray varved CLAY	CH		20.0	S5	SS	0.0	WOH-WOH-1-1	1	2.0 2.0	Wc = 53.05%
		22.0 - 24.0 Grayish brown varved CLAY	CH		22.0	S6	SS	0.0	1-1-2-2	3	2.0 2.0	Wc = 48.9%, LL = 54, PI = 28
		24.0 - 26.0 Reddish brown varved CLAY	CH		24.0	S7	SS	0.0	WOH-WOH-1-2	1	2.0 2.0	Wc = 52.42%
		26.0 - 28.0 Reddish brown varved CLAY	CH		26.0	S8	SS	0.0	WOH-WOH-2-2	2	2.0 2.0	Wc = 42.78%
		28.0 - 30.0 Reddish brown varved CLAY	CH		28.0	S9	SS	0.0	2-2-3-3	5	2.0 2.0	Wc = 51.53%
		30.0 - 32.0 Brown varved CLAY	CH		30.0	S10	SS	0.0	2-3-3-2	6	2.0 2.0	Wc = 55.0%, LL = 56, PI = 31
		32.0 - 34.0 Reddish brown varved CLAY	CH		32.0	S11	SS	0.0	WOH-WOH-2-2	2	2.0 2.0	Wc = 48.98%
		34.0 - 35.0 Reddish brown varved CLAY	CH		34.0							Wc = 40.03%
		35.0 - 36.0 Reddish brown SANDY CLAY with fine gravel (GLACIAL TILL)	CL-SM		35.0	S12	SS	0.0	3-3-3-4	6	2.0 2.0	
		36.0 - 40.0 Brown CLAY with some fine to coarse sand and little fine gravel (GLACIAL TILL)	CL-SM		36.0							Wc = 13.9%
40		Log continued on next page										

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: AmeriDrill, Inc
DRILLER: T. Brown

GA INSPECTOR: D.Gorman
CHECKED BY: M. McNeilly
DATE: 10/17/05



RECORD OF BOREHOLE RD-4


SHEET 2 of 2

PROJECT: 216 Paterson Plank Road
PROJECT NUMBER: 943-6222
DRILLED DEPTH: 45.0 ft
AZIMUTH: N/A
LOCATION: See Boring Location Plan

DRILL METHOD: Hollow-Stem Auger
DRILL RIG: Canterra CT 250
DATE STARTED: 9/16/05
DATE COMPLETED: 9/16/05
WEATHER: Overcast

DATUM:
COORDS: not surveyed
GS ELEVATION: 4.0 ft
TOC ELEVATION: N/A
TEMPERATURE: 82 degrees (F)

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

		SOIL PROFILE			SAMPLES							
DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	PID (ppm)	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT	COMMENTS
					DEPTH (ft)							
40					40.0							AUGER to 43.0 FT BGS without sampling
					-39.0							
	-40	43.0 - 45.0 Reddish brown SILTY CLAY with fine gravel (GLACIAL TILL)	CL-SM		43.0	S14	SS	0.0	50/3"	50/3"	0.3 2.0	
45		Boring completed at 45.0 ft			-41.0							Boring terminated at 45.0 FT BGS at AUGER REFUSAL in GLACIAL TILL
-45												
50												
-50												
55												
-55												
60												
-60												
65												
-65												
70												
-70												
75												
-75												
80												

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: AmeriDrill, Inc
DRILLER: T. Brown

GA INSPECTOR: D.Gorman
CHECKED BY: M. McNeilly
DATE: 10/17/05



RECORD OF BOREHOLE RD-5



















SHEET 1 of 2

PROJECT: 216 Paterson Plank Road
PROJECT NUMBER: 943-6222
DRILLED DEPTH: 43.0 ft
AZIMUTH: N/A
LOCATION: See Boring Locations Plan

DRILL METHOD: Hollow-Stem Auger
DRILL RIG: Canterra CT 250
DATE STARTED: 9/19/05
DATE COMPLETED: 9/19/05
WEATHER: Sunny

DATUM:
COORDS: not surveyed
GS ELEVATION: 4.5 ft
TOC ELEVATION: N/A
TEMPERATURE: 80 degrees (F)

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE			SAMPLES							COMMENTS	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV.	NUMBER	TYPE	PID (ppm)	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT		
					DEPTH (ft)								
0	0	0.0 - 6.0 Gray miscellaneous fill including clayey sand, gravel, brick and concrete fragments (FILL)											Description of FILL based on observed drill cuttings. AUGER to 6.0 FT BGS without sampling, FILL
5	0	6.0 - 8.0 Black organic CLAY and PEAT	PT-OL		-1.5 6.0	ST-1	SH	1.3	PUSH	PUSH	1.0 2.0	Wc = 54.82%	
		8.0 - 10.0 Black fibrous PEAT	PT		-3.5 8.0	ST-2	SH	1.0	PUSH	PUSH	2.0 2.0	Wc = 41.15%; Cc = 0.27, Cv = 2.4 x 10 ⁻⁶ cm ² /sec	
10	-5	10.0 - 12.0 Gray and brown varved CLAY	CL		-5.5 10.0	S1	SS	28.2	6-8-7-7	15	2.0 2.0	Wc = 30.87%, LL = 37, PI = 15	
		12.0 - 14.0 Gray varved CLAY with pieces of wood	CL		-7.5 12.0	S2	SS	42.8	3-2-1-1	3	2.0 2.0	Wc = 37.1%	
15	-10	14.0 - 16.0 Gray varved CLAY	CL		-9.5 14.0	ST-3	SH	16.9	PUSH	PUSH	2.0 2.0	Wc = 41.36%, Su = 402 psf	
		16.0 - 18.0 Gray varved CLAY	CH		-11.5 16.0	ST-4	SH	2.5	PUSH	PUSH	2.0 2.0	Wc = 43.88%, LL = 53, PI = 28; Cc = 0.4, Cv = 2.2 x 10 ⁻⁶ cm ² /sec	
		18.0 - 20.0 Grayish brown varved CLAY	CH		-13.5 18.0	S3	SS	9.5	1-1-1-1	2	2.0 2.0	Wc = 43.6%	
20	-15	20.0 - 22.0 Gray varved CLAY	CH		-15.5 20.0	S4	SS	4.2	1-1-1-1	2	2.0 2.0	Wc = 51.50%	
		22.0 - 24.0 Grayish brown varved CLAY	CH		-17.5 22.0	S5	SS	3.6	1-1-2-2	3	2.0 2.0	Wc = 50.29%	
		24.0 - 26.0 Grayish brown varved CLAY	CH		-19.5 24.0	S6	SS	0.3	WOH-WOH	0	2.0 2.0	Wc = 50.79%, LL = 51, PI = 26	
25	-20	26.0 - 28.0 Grayish brown varved CLAY	CH		-21.5 26.0	S7	SS	0.4	WOH-7-1-1	8	2.0 2.0	Wc = 54.6%	
		28.0 - 30.0 Reddish brown varved CLAY	CH		-23.5 28.0	ST-5	SH	4.7	PUSH	PUSH	2.0 2.0	Wc = 45.69%, Su = 365 psf; Cc = 0.67, Cv = 2.5 x 10 ⁻⁶ cm ² /sec	
30	-25	30.0 - 32.0 Reddish brown varved CLAY	CL		-25.5 30.0	S8	SS	0.4	WOH-WOH	0	2.0 2.0	Wc = 35.70%, LL = 48, PI = 24	
		32.0 - 34.0 Reddish brown varved CLAY	CH		-27.5 32.0	S9	SS	0.3	1-2-1-2	3	2.0 2.0	Wc = 53.78%	
		34.0 - 36.0 Brown varved CLAY	CH		-29.5 34.0	S10	SS	0.4	WOH-3-2-2	5	2.0 2.0	Wc = 53.6%, LL = 50, PI = 28	
35	-30	36.0 - 38.0 Reddish brown varved CLAY	CH		-31.5 36.0	S11	SS	0.2	1-3-3-2	6	2.0 2.0	Wc = 51.96%	
		38.0 - 40.0 Brown CLAY with fine to coarse sand and trace fine gravel (GLACIAL TILL)	CL-SM		-33.5 38.0	S12	SS	0.2	8-11-18-22	26	2.0 2.0	Wc = 18.5%	
40	-35	Log continued on next page											

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: AmeriDrill, Inc
DRILLER: T. Brown

GA INSPECTOR: D.Gorman
CHECKED BY: M. McNeilly
DATE: 10/17/05



AA GEOTECH LOG CARLSTADT RD BORINGS.GPJ GOLDER NL-PA.GDT 12/2/05

SHEET 2 of 2
INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DATUM:
COORDS: not surveyed
GS ELEVATION: 4.5 ft
TOC ELEVATION: N/A
TEMPERATURE: 80 degrees (F)

AUGER to 43.0 FT BGS without sampling

Boring terminated at 43.0 FT BGS at AUGER REFUSAL in GLACIAL TILL



**Golder
Associates**

APPENDIX B

GEOTECHNICAL LABORATORY TESTING RESULTS

MOISTURE CONTENT

ASTM D 2216

CARLSTADT PRP/FACILITY COORDINATOR		DATE	10/24/05		
943-6222.0300		TECH	ND		
		REVIEW	RMW		
MOISTURE CONTENT (Delivered Moisture)					
Sample Identification	S1	S2	S7	S9	S10
Boring #	RD-1	RD-1	RD-1	RD-1	RD-1
Depth	4'-6'	6'-8'	20'-22'	24'-26'	26'-28'
tare #	RD1	T9	RD3	EF2	F026
wt soil&tare,moist (g)	121.06	142.53	121.42	115.19	140.60
wt soil&tare,dry (g)	105.25	119.86	110.58	104.71	123.31
wt tare (g)	39.56	37.62	37.71	39.42	32.16
wt moisture (g)	15.81	22.67	10.84	10.48	17.29
wt dry soil (g)	65.69	82.24	72.87	65.29	91.15
% moisture	24.07%	27.57%	14.88%	16.05%	18.97%

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

MOISTURE CONTENT

ASTM D 2216

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

DATE	10/24/05
TECH	ND
REVIEW	RMW

MOISTURE CONTENT (Delivered Moisture)

Sample Identification	S6	S7
Boring #	RD-2	RD-2
Depth	23'-25'	20'-30'
tare #	RW2	1KT
wt soil&tare,moist (g)	220.43	165.99
wt soil&tare,dry (g)	210.28	158.00
wt tare (g)	151.67	102.70
wt moisture (g)	10.15	7.99
wt dry soil (g)	58.61	55.30
% moisture	17.32%	14.45%

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

MOISTURE CONTENT

ASTM D 2216

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

DATE	10/24/05
TECH	ND
REVIEW	RMW

MOISTURE CONTENT (Delivered Moisture)

Sample Identification	ST-1	S3	S5	S7	S9
Boring #	RD-3	RD-3	RD-3	RD-3	RD-3
Depth	6'-8'	12'-14'	20'-22'	28'-30'	38'-40'
tare #	CH012	GH8	RW18	RW3	MM72
wt soil&tare,moist (g)	174.02	221.52	218.69	223.58	262.78
wt soil&tare,dry (g)	132.58	203.30	200.32	212.10	254.68
wt tare (g)	50.26	155.10	153.40	155.20	163.97
wt moisture (g)	41.44	18.22	18.37	11.48	8.10
wt dry soil (g)	82.32	48.20	46.92	56.90	90.71
% moisture	50.34%	37.80%	39.15%	20.18%	8.93%

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

MOISTURE CONTENT

ASTM D 2216

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

DATE 10/29/05
TECH ND
REVIEW RMW

MOISTURE CONTENT (Delivered Moisture)

Sample Identification	ST-1	S1	S2	S4	S5
Boring #	RD-4	RD-4	RD-4	RD-4	RD-4
Depth	4'-6'	8'-10'	10'-12'	16'-18'	20'-22'
tare #	CH23	GH12	GH19	GH8	RW13
wt soil&tare,moist (g)	174.22	216.93	227.73	235.33	223.29
wt soil&tare,dry (g)	153.21	201.58	211.33	210.50	198.66
wt tare (g)	52.13	151.50	155.70	156.42	152.23
wt moisture (g)	21.01	15.35	16.40	24.83	24.63
wt dry soil (g)	101.08	50.08	55.63	54.08	46.43
% moisture	20.79%	30.65%	29.48%	45.91%	53.05%

MOISTURE CONTENT (Delivered Moisture)

Sample Identification	S7	S8	S9	S11	S12
Boring #	RD-4	RD-4	RD-4	RD-4	RD-4
Depth	24'-26'	26'-28'	28'-30'	32'-34'	34'-36'
tare #	RW16	GH20	GH2	RW15	GH14
wt soil&tare,moist (g)	244.54	244.26	245.98	219.13	218.53
wt soil&tare,dry (g)	213.77	217.26	216.48	198.62	201.09
wt tare (g)	155.07	154.14	159.23	156.75	157.52
wt moisture (g)	30.77	27.00	29.50	20.51	17.44
wt dry soil (g)	58.70	63.12	57.25	41.87	43.57
% moisture	52.42%	42.78%	51.53%	48.98%	40.03%

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

MOISTURE CONTENT

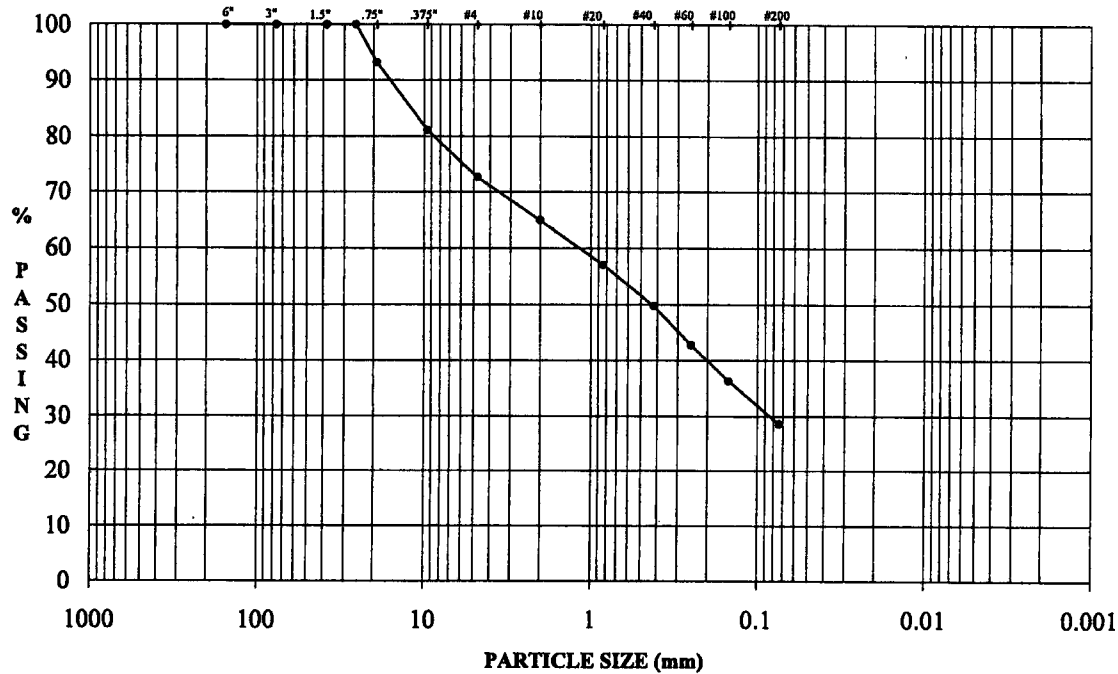
ASTM D 2216

CARLSTADT PRP/FACILITY COORDINATOR		DATE	11/03/05		
943-6222.0300		TECH	RDD		
		REVIEW	RMW		
MOISTURE CONTENT (Delivered Moisture)					
Sample Identification	ST-1	S4	S5	S9	S11
Boring #	RD-5	RD-5	RD-5	RD-5	RD-5
Depth	6'-8'	20'-22'	22'-24'	32'-34'	36'-38'
tare #	R24	RW6	GH1	GH3	RW8
wt soil&tare,moist (g)	212.38	205.42	212.09	214.97	221.59
wt soil&tare,dry (g)	155.32	187.23	193.00	193.99	199.20
wt tare (g)	51.24	151.91	155.04	154.98	156.11
wt moisture (g)	57.06	18.19	19.09	20.98	22.39
wt dry soil (g)	104.08	35.32	37.96	39.01	43.09
% moisture	54.82%	51.50%	50.29%	53.78%	51.96%

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

PARTICLE-SIZE DISTRIBUTION ASTM D 422

US STANDARD SIEVE OPENING SIZES



Sample Data

% Gravel	27.3
% Sand	44.0
% Fines	28.6
C _c	N/A
C _u	N/A
LL	-
PL	-
PI	-
USCS	-
w (%)	14.3
Percent Finer	
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	93.2%
3/8"	81.1%
#4	72.7%
#10	65.0%
#20	57.1%
#40	49.8%
#60	42.8%
#100	36.3%
#200	28.6%

COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay
	GRAVEL		SAND			FINES

COMMENTS:

DESCRIPTION

Sample:	RD-1
	S3
Depth:	10'-12'

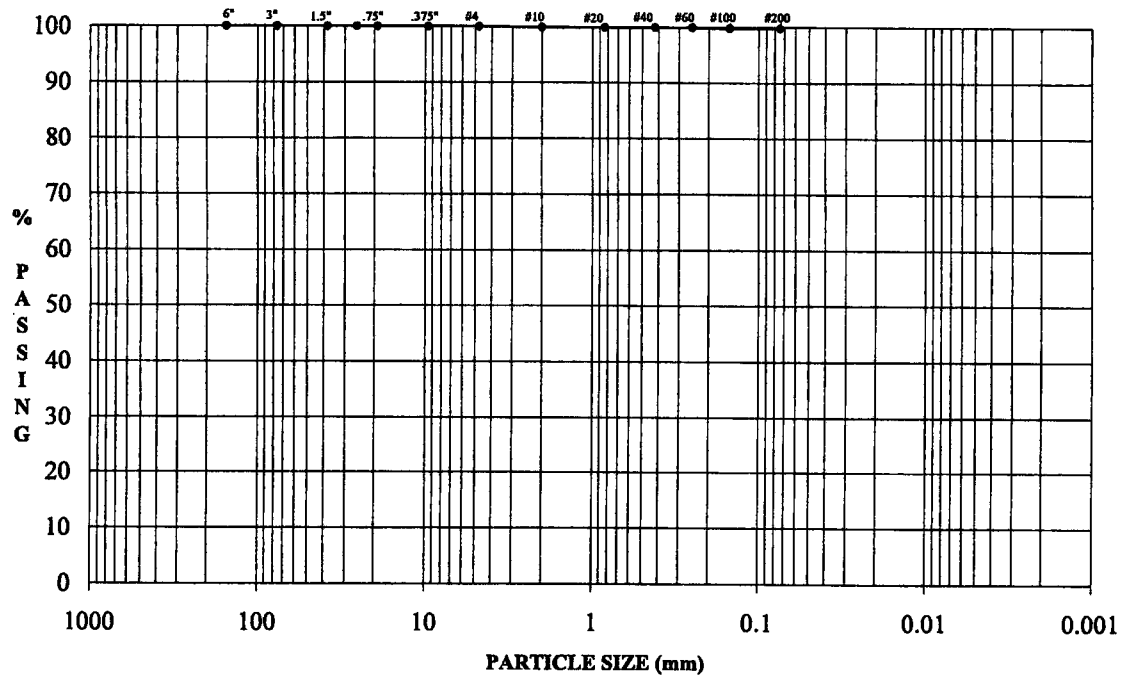
Wet Color: Brown
Description: Sandy clay with some fine gravel

Date:	10/24/05
Technician:	RDD
Reviewer:	RMW

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



Sample Data

% Gravel	0.0
% Sand	0.2
% Fines	99.8
C _c	N/A
C _u	N/A
LL	-
PL	-
PI	-
USCS	-
w (%)	44.9
Percent Finer	
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	100.0%
#4	100.0%
#10	99.9%
#20	99.9%
#40	99.9%
#60	99.9%
#100	99.8%
#200	99.8%

COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay FINES
	GRAVEL		SAND			

COMMENTS:

DESCRIPTION

Sample: RD-1
S6

Depth: 18'-20'

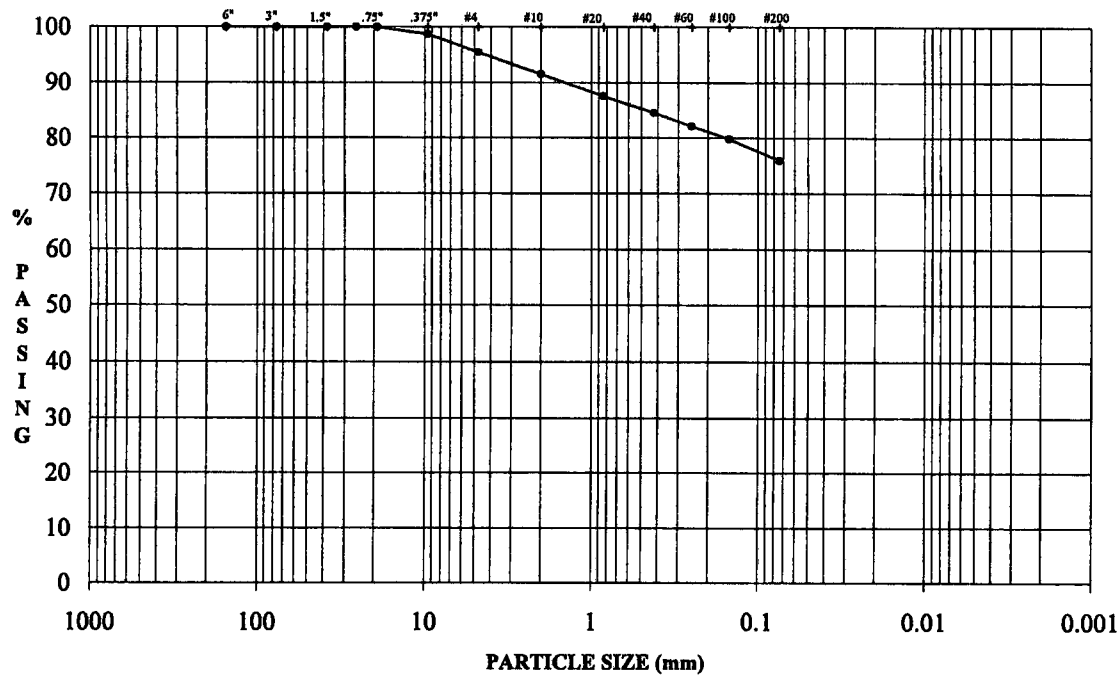
Wet Color: Brown
Description: Clay with
trace fine sand

Date: 10/24/05
Technician: RDD
Reviewer: RMW

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



Sample Data

% Gravel	4.6
% Sand	19.6
% Fines	75.9
C _c	N/A
C _u	N/A
LL	-
PL	-
PI	-
USCS	-
w (%)	28.9
Percent Finer	
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	98.7%
#4	95.4%
#10	91.5%
#20	87.5%
#40	84.5%
#60	82.1%
#100	79.8%
#200	75.9%

COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay FINES
	GRAVEL		SAND			

COMMENTS:

DESCRIPTION

Sample: **RD-1**
S8

Depth: **22'-24'**

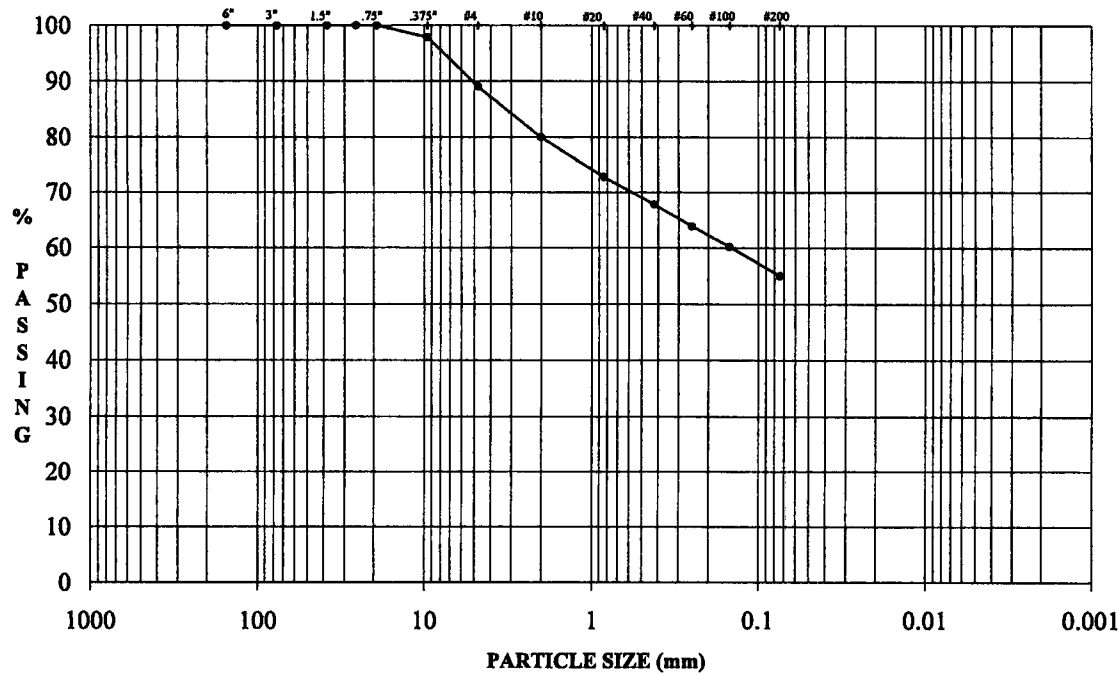
Wet Color: **Brown**
Description: **Clay with trace fine to coarse sand and fine gravel**

Date: **10/24/05**
Technician: **RDD**
Reviewer: **RMW**

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943-6222.0300

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PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



Sample Data

% Gravel	11.0
% Sand	34.0
% Fines	55.0
C _c	N/A
C _u	N/A
LL	-
PL	-
PI	-
USCS	-
w (%)	18.9
Percent Finer	
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	97.9%
#4	89.0%
#10	80.0%
#20	72.8%
#40	67.8%
#60	63.9%
#100	60.2%
#200	55.0%

COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay
	GRAVEL		SAND			FINES

COMMENTS:

DESCRIPTION

Sample: RD-1
S11
Depth: 28'-30'

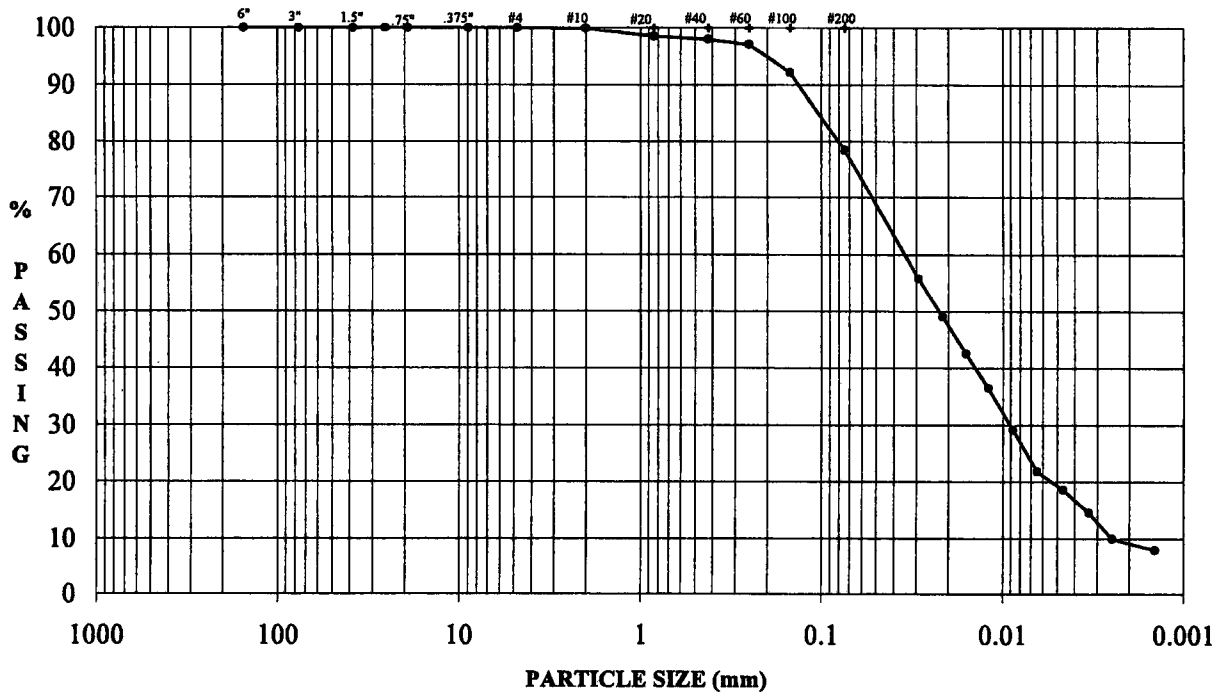
Wet Color: Brown
Description: Clay with trace fine to coarse sand
fine gravel

Date: 10/24/05
Technician: RDD
Reviewer: RMW

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PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay FINES
	GRAVEL		SAND			

Sieve Data

Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	100.0%
#4	100.0%
#10	99.9%
#20	98.5%
#40	98.0%
#60	97.1%
#100	92.2%
#200	78.5%

Hydrometer Data

Particle Diameter	% Finer
0.029	55.8%
0.022	49.1%
0.016	42.5%
0.012	36.5%
0.009	29.2%
0.006	21.9%
0.005	18.6%
0.003	14.6%
0.002	10.0%
0.001	8.0%

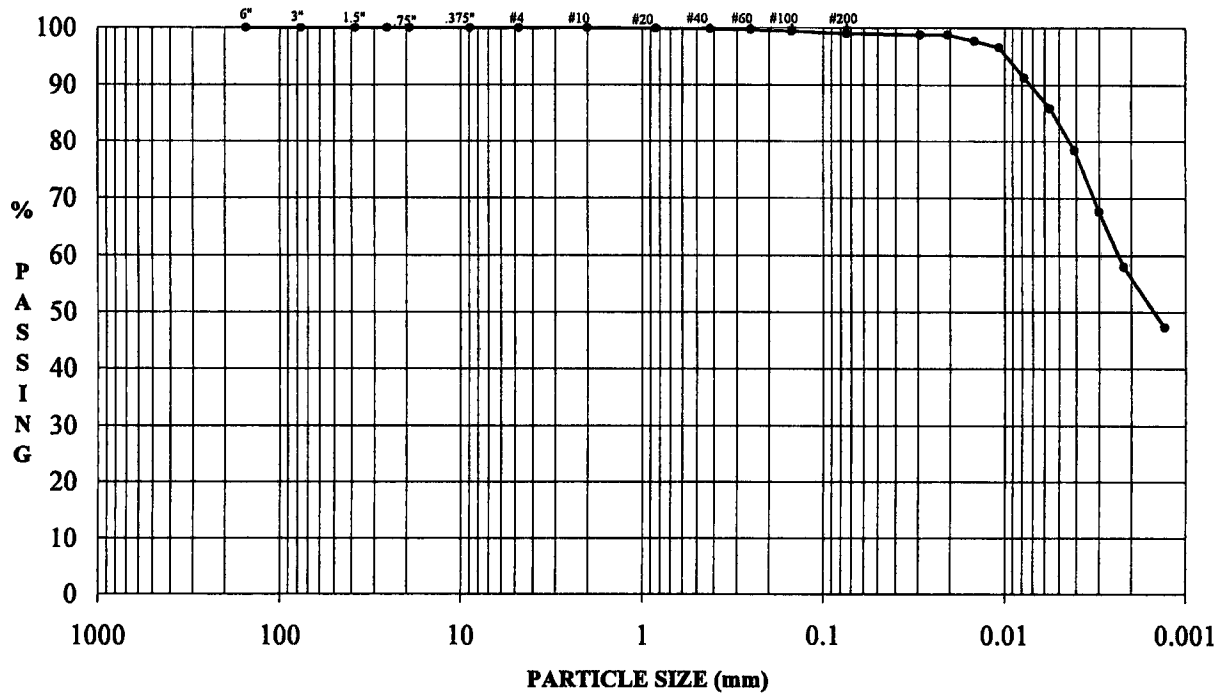
DESCRIPTION				SAMPLE DATA				
Sample:	RD-1	Depth:	8'-10'	W _c (%):	63.3	(ASSUMED)	C _c	N/A
	ST-1	USCS:	MH	G _s :	2.65		C _u	N/A
Wet Color:	Black			% Gravel	0.0		LL	85
Description:	Silty clay with trace			% Sand	21.5		PL	47
	fine gravel			% Fines	78.5		PI	38
Comments:							Date:	11/08/05

Date: 11/08/05
Technician: KD
Reviewer: RMW

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PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay FINES
	GRAVEL		SAND			

Sieve Data

Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	100.0%
#4	100.0%
#10	100.0%
#20	99.9%
#40	99.8%
#60	99.7%
#100	99.4%
#200	99.0%

Hydrometer Data

Particle Diameter	% Finer
0.029	98.8%
0.021	98.8%
0.015	97.7%
0.011	96.6%
0.008	91.2%
0.006	85.9%
0.004	78.4%
0.003	67.6%
0.002	58.0%
0.001	47.2%

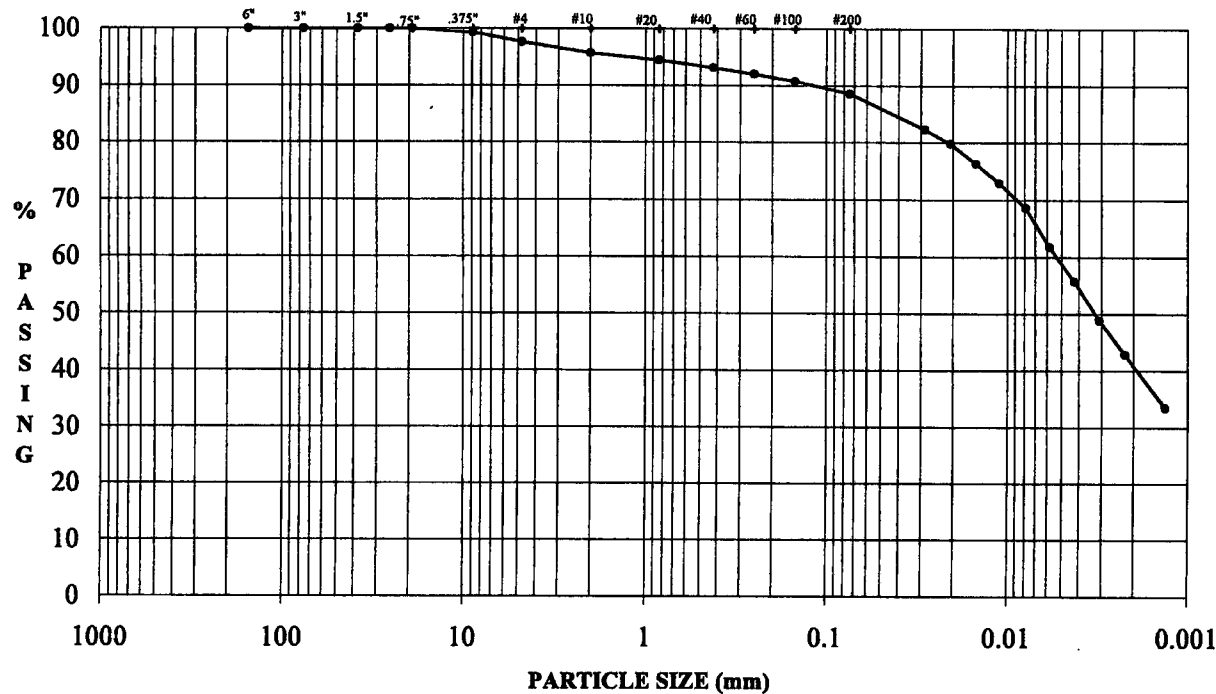
DESCRIPTION				SAMPLE DATA				
Sample:	RD-2	Depth:	11'-13'	W _c (%):	43.1	(ASSUMED)	C _c	N/A
	S2	USCS:	-	G _s :	2.65		C _u	N/A
Wet Color:	Grayish brown			% Gravel	0.0		LL	-
Description:	Clay with little silt and trace fine sand			% Sand	1.0		PL	-
				% Fines	99.0		PI	-
Comments:							Date:	10/25/05

Date: 10/25/05
Technician: RDD
Reviewer: RMW

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943-6222.0300

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CHERRY HILL, NEW JERSEY

PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay FINES
	GRAVEL		SAND			

Sieve Data

Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	99.3%
#4	97.6%
#10	95.7%
#20	94.5%
#40	93.2%
#60	92.1%
#100	90.7%
#200	88.6%

Hydrometer Data

Particle Diameter	% Finer
0.028	82.3%
0.021	79.8%
0.015	76.3%
0.011	72.9%
0.008	68.6%
0.006	61.7%
0.004	55.7%
0.003	48.9%
0.002	42.9%
0.001	33.4%

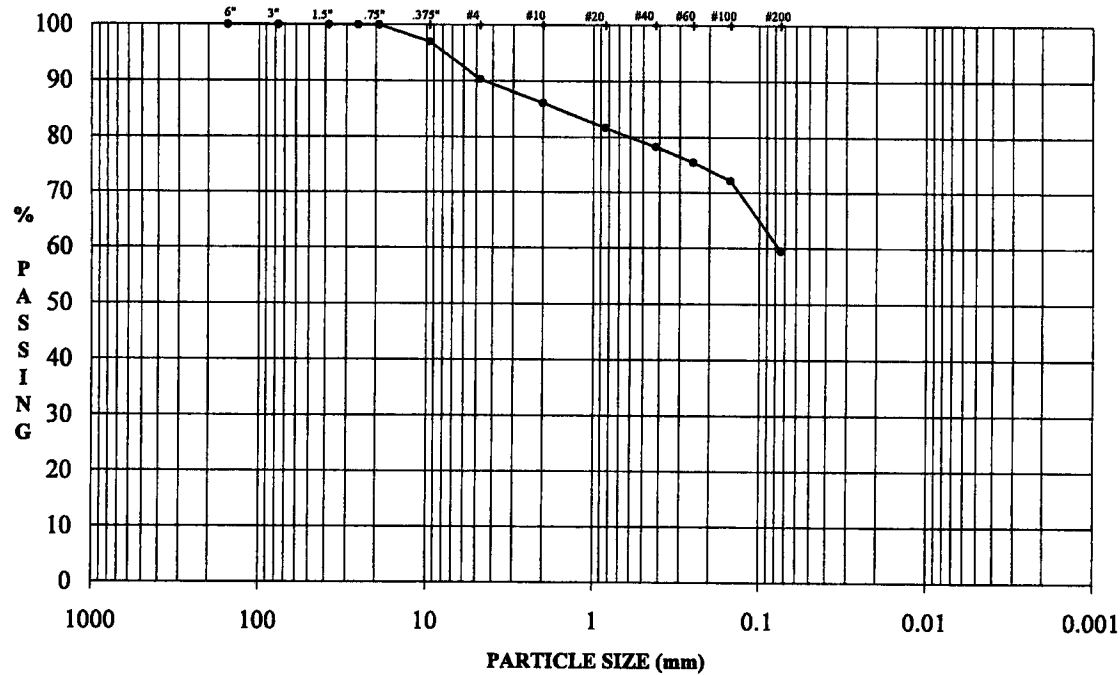
DESCRIPTION				SAMPLE DATA				
Sample:	RD-2	Depth:	17'-19'	W _C (%):	38.1	(ASSUMED)	C _C	N/A
	S4	USCS:	-	G _S :	2.65		C _U	N/A
Wet Color:	Brown			% Gravel	2.4		LL	-
Description:	Clay and silt with trace fine sand and gravel			% Sand	9.0		PL	-
Comments:				% Fines	88.6		PI	-
							Date:	10/25/05

Date: 10/25/05
Technician: RDD
Reviewer: RMW

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943-6222.0300

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CHERRY HILL, NEW JERSEY

PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



Sample Data

% Gravel	9.8
% Sand	30.7
% Fines	59.5
C _c	N/A
C _u	N/A
LL	-
PL	-
PI	-
USCS	-
w (%)	15.2
Percent Finer	
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	96.9%
#4	90.2%
#10	86.0%
#20	81.6%
#40	78.3%
#60	75.5%
#100	72.2%
#200	59.5%

COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay FINES
	GRAVEL		SAND			

COMMENTS:

DESCRIPTION

Sample: RD-2
S5
Depth: 21'-23'

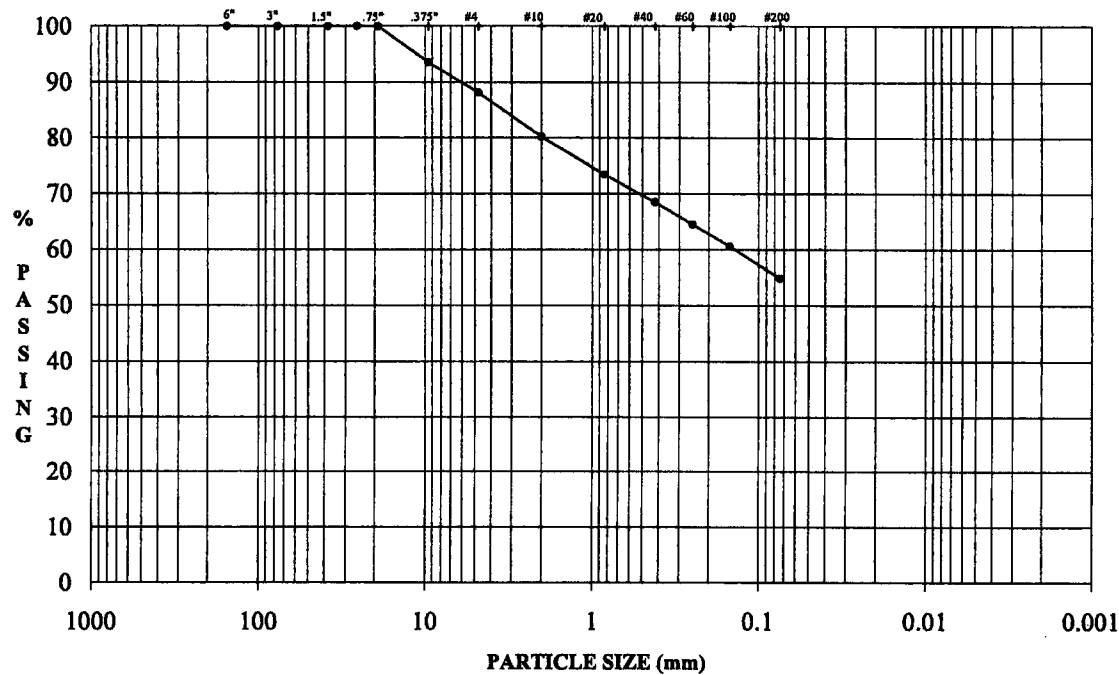
Wet Color: Brown
Description: Clay with trace to little
fine sand and gravel

Date: 10/24/05
Technician: RDD
Reviewer: RMW

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943-6222.0300

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CHERRY HILL, NEW JERSEY

PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay
	GRAVEL		SAND			FINES

Sample Data

% Gravel	11.8
% Sand	33.3
% Fines	54.8
C _c	N/A
C _u	N/A
LL	-
PL	-
PI	-
USCS	-
w (%)	13.9

Percent Finer

3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	93.5%
#4	88.2%
#10	80.1%
#20	73.3%
#40	68.6%
#60	64.6%
#100	60.7%
#200	54.8%

COMMENTS:

DESCRIPTION

Sample: RD-2
S8
Depth: 33'-35'

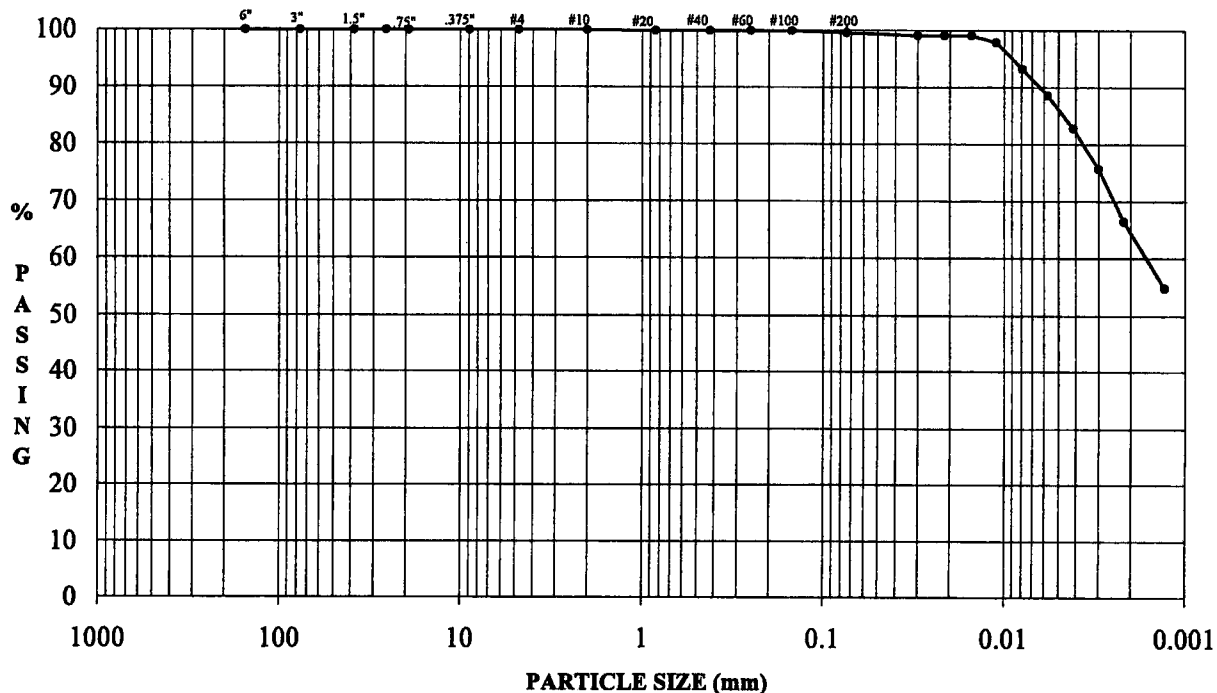
Wet Color: Brown
Description: Caly and medium to fine sand
with little fine gravel

Date: 10/24/05
Technician: RDD
Reviewer: RMW

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay FINES
	GRAVEL		SAND			

Sieve Data

Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	100.0%
#4	100.0%
#10	100.0%
#20	99.9%
#40	99.9%
#60	99.9%
#100	99.9%
#200	99.6%

Hydrometer Data

Particle Diameter	% Finer
0.030	99.1%
0.021	99.1%
0.015	99.1%
0.011	97.9%
0.008	93.2%
0.006	88.6%
0.004	82.8%
0.003	75.8%
0.002	66.4%
0.001	54.8%

DESCRIPTION				SAMPLE DATA				
Sample:	RD-3	Depth: 16'-18'		W _C (%):	54.0	(ASSUMED)	C _C	N/A
	S4	USCS: CH		G _S :	2.65		C _U	N/A
Wet Color:	Brown			% Gravel	0.0		LL	56
Description:	Clay with trace silt			% Sand	0.4		PL	25
				% Fines	99.6		PI	31
Comments:							Date:	10/25/05

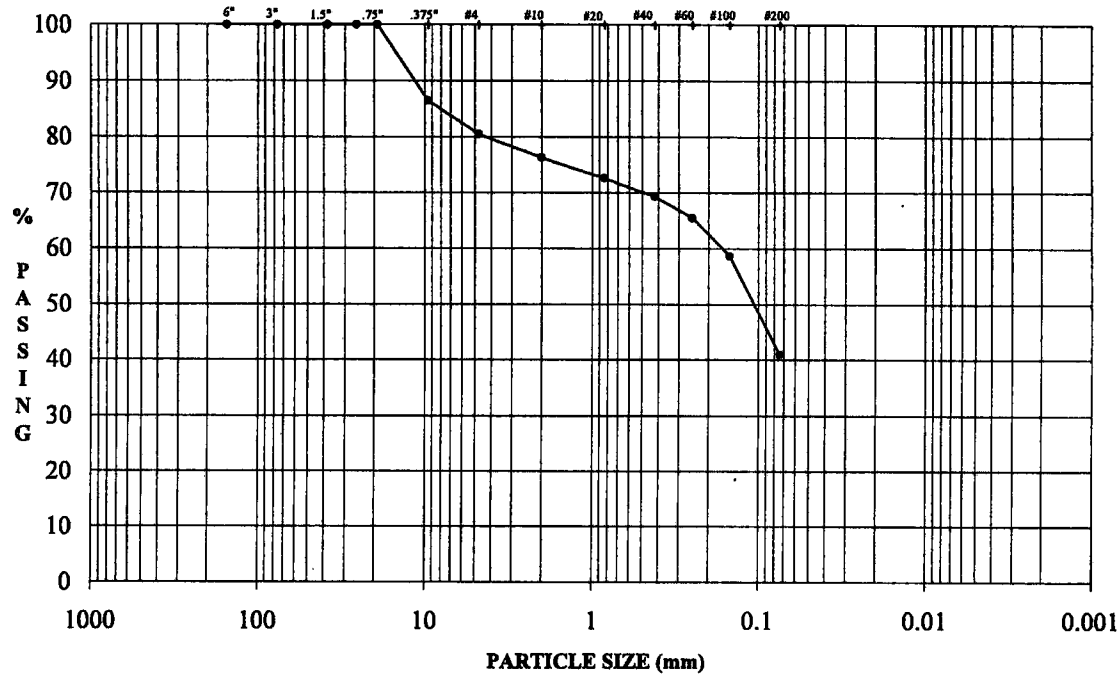
Date: 10/25/05
Technician: RDD
Reviewer: RMW

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PARTICLE-SIZE DISTRIBUTION ASTM D 422						US STANDARD SIEVE OPENING SIZES		Sample Data																											
								% Gravel	15.3																										
								% Sand	40.2																										
								% Fines	44.5																										
								C _c	N/A																										
								C _u	N/A																										
								LL	-																										
								PL	-																										
								PI	-																										
								USCS	-																										
								w (%)	14.4																										
<table border="1"> <thead> <tr> <th colspan="2">Percent Finer</th> </tr> </thead> <tbody> <tr> <td>3"</td> <td>100.0%</td> </tr> <tr> <td>1 1/2"</td> <td>100.0%</td> </tr> <tr> <td>1"</td> <td>100.0%</td> </tr> <tr> <td>3/4"</td> <td>96.1%</td> </tr> <tr> <td>3/8"</td> <td>92.5%</td> </tr> <tr> <td>#4</td> <td>84.7%</td> </tr> <tr> <td>#10</td> <td>76.0%</td> </tr> <tr> <td>#20</td> <td>68.0%</td> </tr> <tr> <td>#40</td> <td>61.8%</td> </tr> <tr> <td>#60</td> <td>56.7%</td> </tr> <tr> <td>#100</td> <td>51.5%</td> </tr> <tr> <td>#200</td> <td>44.5%</td> </tr> </tbody> </table>								Percent Finer		3"	100.0%	1 1/2"	100.0%	1"	100.0%	3/4"	96.1%	3/8"	92.5%	#4	84.7%	#10	76.0%	#20	68.0%	#40	61.8%	#60	56.7%	#100	51.5%	#200	44.5%		
								Percent Finer																											
								3"	100.0%																										
								1 1/2"	100.0%																										
								1"	100.0%																										
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								#4	84.7%																										
								#10	76.0%																										
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#60	56.7%																																		
#100	51.5%																																		
#200	44.5%																																		
<table border="1"> <thead> <tr> <th>COBBLE</th> <th>Coarse GRAVEL</th> <th>Fine SAND</th> <th>Cor</th> <th>Med</th> <th>Fine</th> <th>Silt or Clay FINES</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>								COBBLE	Coarse GRAVEL	Fine SAND	Cor	Med	Fine	Silt or Clay FINES								COMMENTS: 													
COBBLE	Coarse GRAVEL	Fine SAND	Cor	Med	Fine	Silt or Clay FINES																													
DESCRIPTION																																			
Sample: RD-3 S6 Depth: 22'-24'		Wet Color: Brown Description: Clay and coarse to fine sand with little fine gravel				Date: 10/24/05 Technician: RDD Reviewer: RMW																													
CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300								GOLDER ASSOCIATES INC. CHERRY HILL, NEW JERSEY																											

PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



Sample Data

% Gravel	19.5
% Sand	39.6
% Fines	40.9
C _c	N/A
C _u	N/A
LL	-
PL	-
PI	-
USCS	-
w (%)	14.9
Percent Finer	
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	86.5%
#4	80.5%
#10	76.3%
#20	72.7%
#40	69.4%
#60	65.5%
#100	58.7%
#200	40.9%

COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay FINES
	GRAVEL		SAND			

COMMENTS:

DESCRIPTION

Sample: RD-3
S8

Depth: 33'-35'

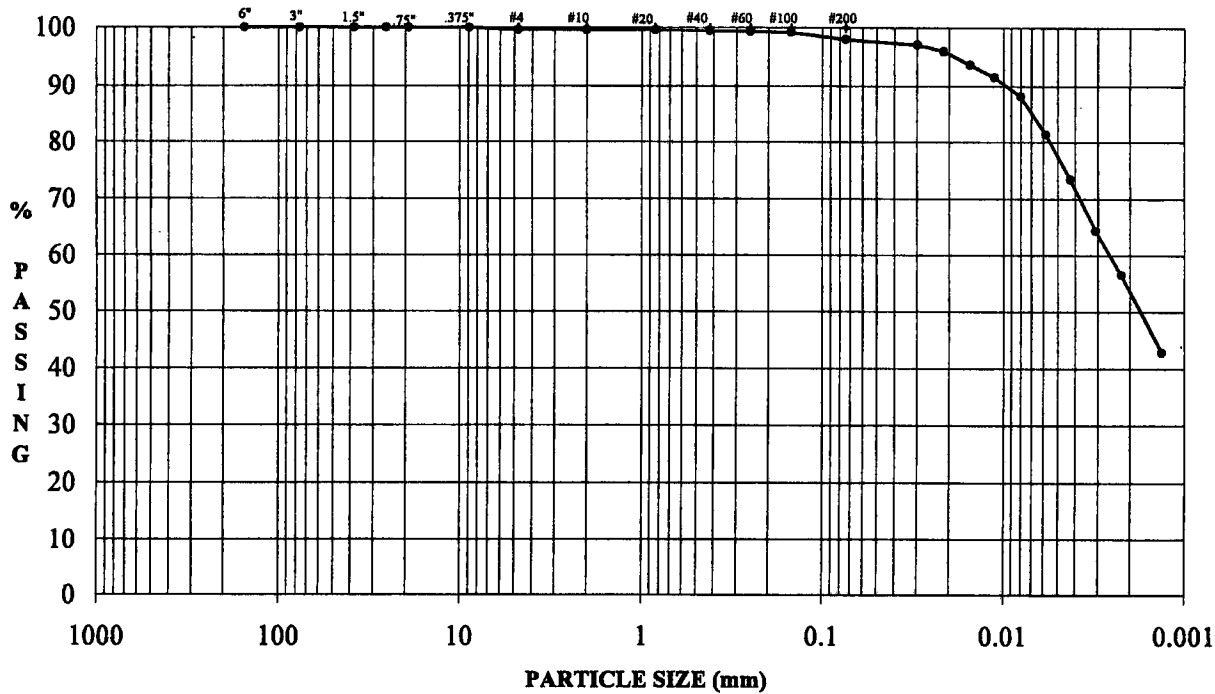
Wet Color: Brown
Description: Clay and coarse to fine sand
with some fine gravel

Date: 10/24/05
Technician: RDD
Reviewer: RMW

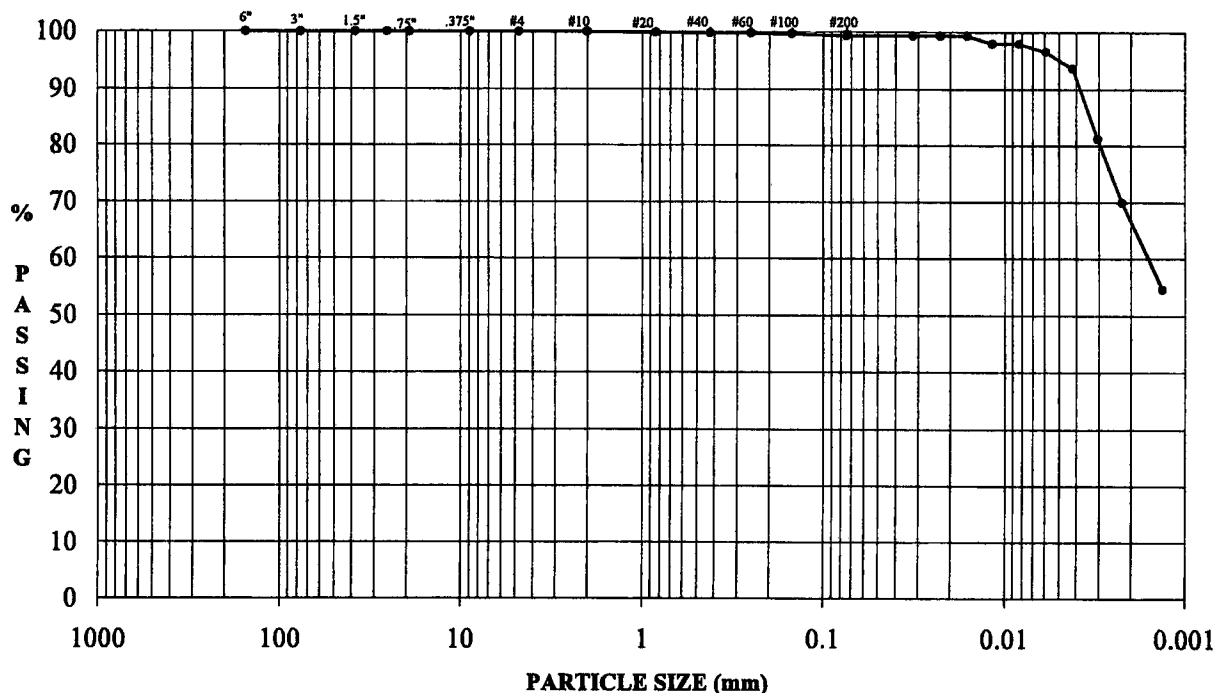
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PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay FINES
	GRAVEL		SAND			

Sieve Data

Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	100.0%
#4	100.0%
#10	100.0%
#20	99.9%
#40	99.8%
#60	99.8%
#100	99.7%
#200	99.4%

Hydrometer Data

Particle Diameter	% Finer
0.032	99.4%
0.023	99.4%
0.016	99.4%
0.012	98.0%
0.008	98.0%
0.006	96.6%
0.004	93.8%
0.003	81.2%
0.002	70.0%
0.001	54.6%

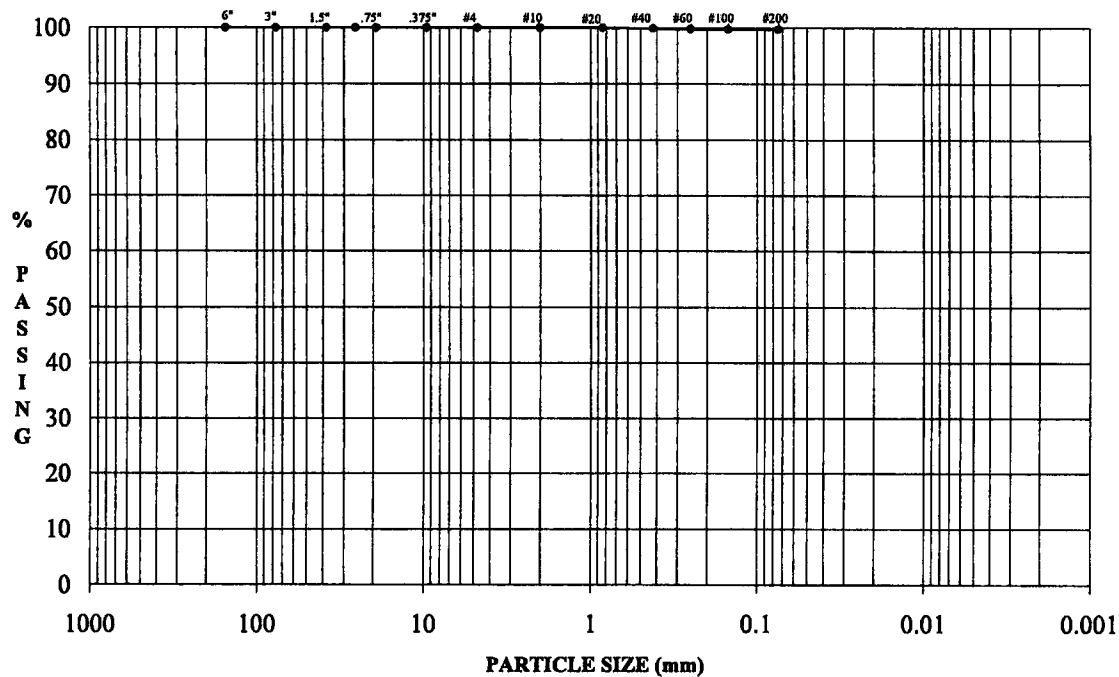
DESCRIPTION				SAMPLE DATA				
Sample: RD-4 S6 Wet Color: Grayish brown Description: Clay with trace silt Comments:	Depth: 22'-24'			W _C (%):	49.9	(ASSUMED)	C _C	N/A
	USCS: CH			G _S :	2.65		C _U	N/A
				% Gravel	0.0		LL	54
				% Sand	0.6		PL	25
				% Fines	99.4		PI	29
							Date:	10/25/05

Date: 10/25/05
Technician: RDD
Reviewer: RMW

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PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay
	GRAVEL		SAND			FINES

Sample Data

% Gravel	0.0
% Sand	0.3
% Fines	99.7
C _c	N/A
C _u	N/A
LL	56
PL	25
PI	31
USCS	CH
w (%)	55.0
Percent Finer	
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	100.0%
#4	100.0%
#10	100.0%
#20	100.0%
#40	99.9%
#60	99.8%
#100	99.7%
#200	99.7%

COMMENTS:

DESCRIPTION

Sample: RD-4
S10

Depth: 30'-32'

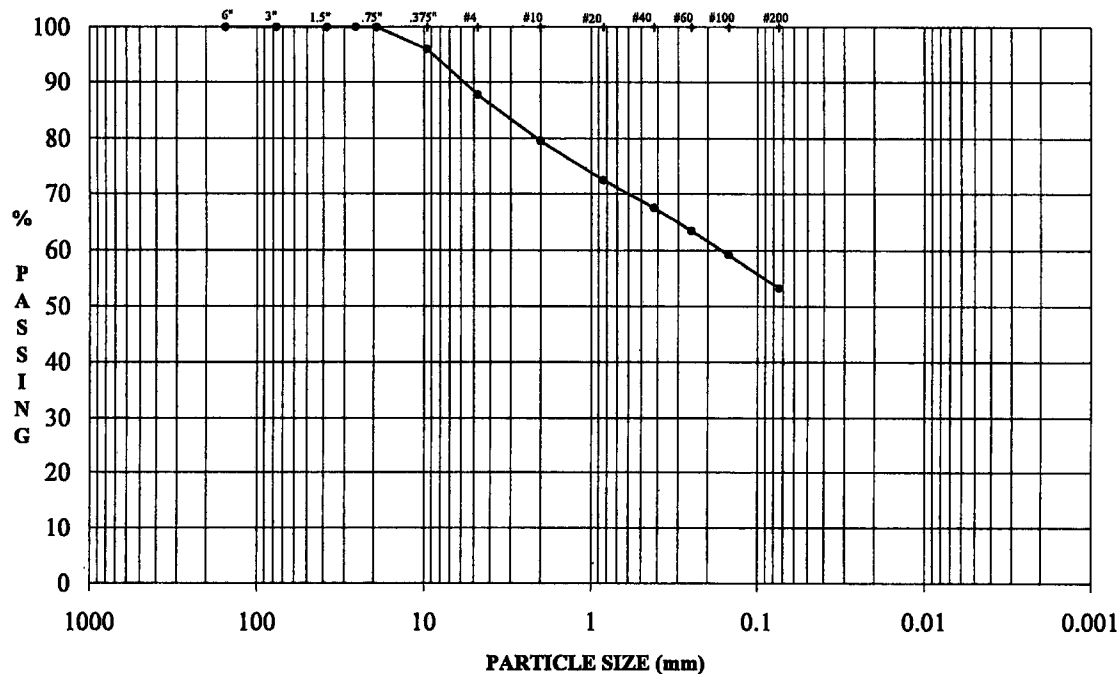
Wet Color: Brown
Description: Clay

Date: 10/28/05
Technician: ND
Reviewer: RMW

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

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PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



Sample Data

% Gravel	12.2
% Sand	34.5
% Fines	53.3
C _c	N/A
C _u	N/A
LL	-
PL	-
PI	-
USCS	-
w (%)	13.9
Percent Finer	
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	96.0%
#4	87.8%
#10	79.6%
#20	72.5%
#40	67.5%
#60	63.4%
#100	59.3%
#200	53.3%

COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay FINES
	GRAVEL		SAND			

COMMENTS:

DESCRIPTION

Sample: RD-4
S13

Depth: 38'-40'

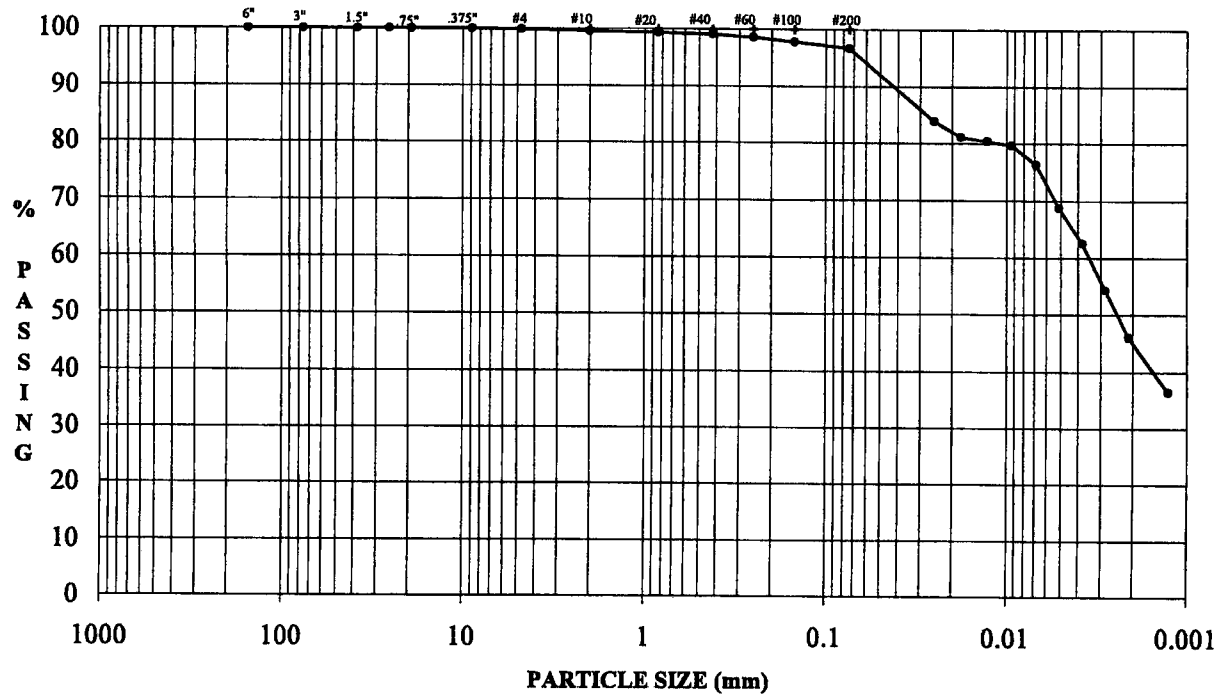
Wet Color: Brown
Description: Clay with some coarse to fine sand and little fine gravel

Date: 10/24/05
Technician: RDD
Reviewer: RMW

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay FINES
	GRAVEL		SAND			

Sieve Data

Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	100.0%
#4	99.9%
#10	99.6%
#20	99.4%
#40	99.1%
#60	98.6%
#100	97.8%
#200	96.7%

Hydrometer Data

Particle Diameter	% Finer
0.025	83.9%
0.018	81.1%
0.013	80.4%
0.009	79.7%
0.007	76.3%
0.005	68.7%
0.004	62.6%
0.003	54.3%
0.002	46.1%
0.001	36.4%

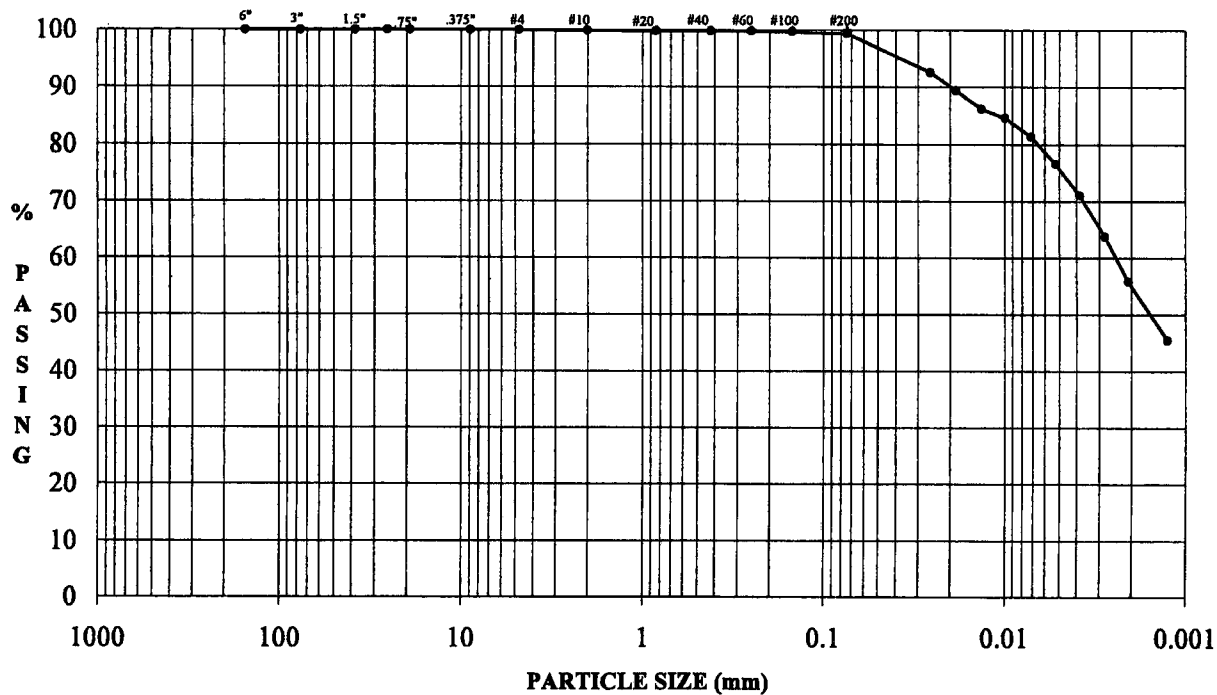
DESCRIPTION				SAMPLE DATA				
Sample:	RD-5	Depth:	12'-14'	W _C (%):	37.1	(ASSUMED)	C _C	N/A
	S2	USCS:	-	G _S :	2.65		C _U	N/A
Wet Color:	Gray			% Gravel	0.1		LL	-
Description:	Clay with some silt and trace fine sand			% Sand	3.2		PL	-
Comments:				% Fines	96.7		PI	-
							Date:	10/25/05

Date: 10/25/05
Technician: RDD
Reviewer: RMW

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay
	GRAVEL		SAND			FINES

Sieve Data

Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	100.0%
#4	100.0%
#10	99.9%
#20	99.8%
#40	99.8%
#60	99.8%
#100	99.7%
#200	99.5%

Hydrometer Data

Particle Diameter	% Finer
0.026	92.5%
0.019	89.3%
0.013	86.2%
0.010	84.6%
0.007	81.4%
0.005	76.6%
0.004	71.0%
0.003	63.8%
0.002	55.8%
0.001	45.5%

DESCRIPTION				SAMPLE DATA				
Sample:	RD-5	Depth: 18'-20'		W _C (%)	43.6	(ASSUMED)	C _C	N/A
	S3	USCS: -		G _S :	2.65		C _U	N/A
Wet Color:	Grayish brown Clay with some silt			% Gravel	0.0		LL	-
Description:				% Sand	0.5		PL	-
				% Fines	99.5		PI	-
Comments:								
							Date:	10/25/05

Date: 10/25/05

Technician: RDD

Reviewer: RMW

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

The graph displays the cumulative percentage of material passing through various sieve sizes. The data points are as follows:

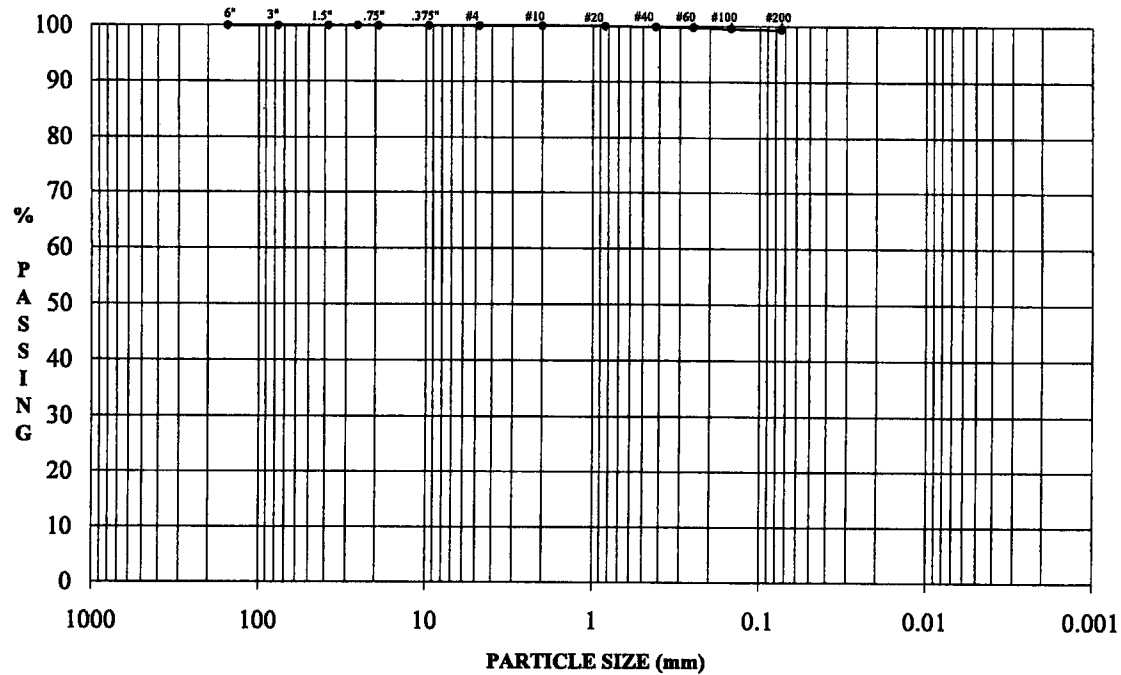
Sieve Size (mm)	Passing %
2.0	100
1.5	100
1.18	100
0.85	100
0.75	100
0.6	100
0.425	100
0.3	100
0.25	100
0.2	100
0.15	100
0.125	100
0.106	100
0.075	90
0.06	89
0.05	88
0.0425	86
0.0375	82
0.03	75
0.025	68
0.02	59
0.015	48

COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay FINES
	GRAVEL		SAND			

Sieve Data	
Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	100.0%
#4	100.0%
#10	100.0%
#20	100.0%
#40	99.9%
#60	99.9%
#100	99.9%
#200	99.8%
Hydrometer Data	
Particle Diameter	% Finer
0.025	91.3%
0.018	89.8%
0.013	88.3%
0.009	87.5%
0.007	83.7%
0.005	80.7%
0.004	75.3%
0.003	69.2%
0.002	60.1%
0.001	49.5%

DESCRIPTION				SAMPLE DATA				
Sample: RD-5 Wet Color: Grayish brown Description: Clay with some silt Comments:	S7	Depth: 26'-28'		W _C (%):	54.6	(ASSUMED)	C _C	N/A
		USCS: -		G _S :	2.65		C _U	N/A
				% Gravel	0.0		LL	-
				% Sand	0.2		PL	-
				% Fines	99.8		PI	-
							Date:	10/25/05
							Technician:	RDD
							Reviewer:	RMW
CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300							GOLDER ASSOCIATES INC. CHERRY HILL, NEW JERSEY	

PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



Sample Data

% Gravel	0.0
% Sand	0.6
% Fines	99.4
C _c	N/A
C _u	N/A
LL	50
PL	22
PI	28
USCS	CH
w (%)	53.6
Percent Finer	
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	100.0%
#4	100.0%
#10	100.0%
#20	100.0%
#40	99.9%
#60	99.8%
#100	99.6%
#200	99.4%

COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay
	GRAVEL		SAND			FINES

COMMENTS:

DESCRIPTION

Sample: **RD-5**
S10

Depth: **34'-36'**

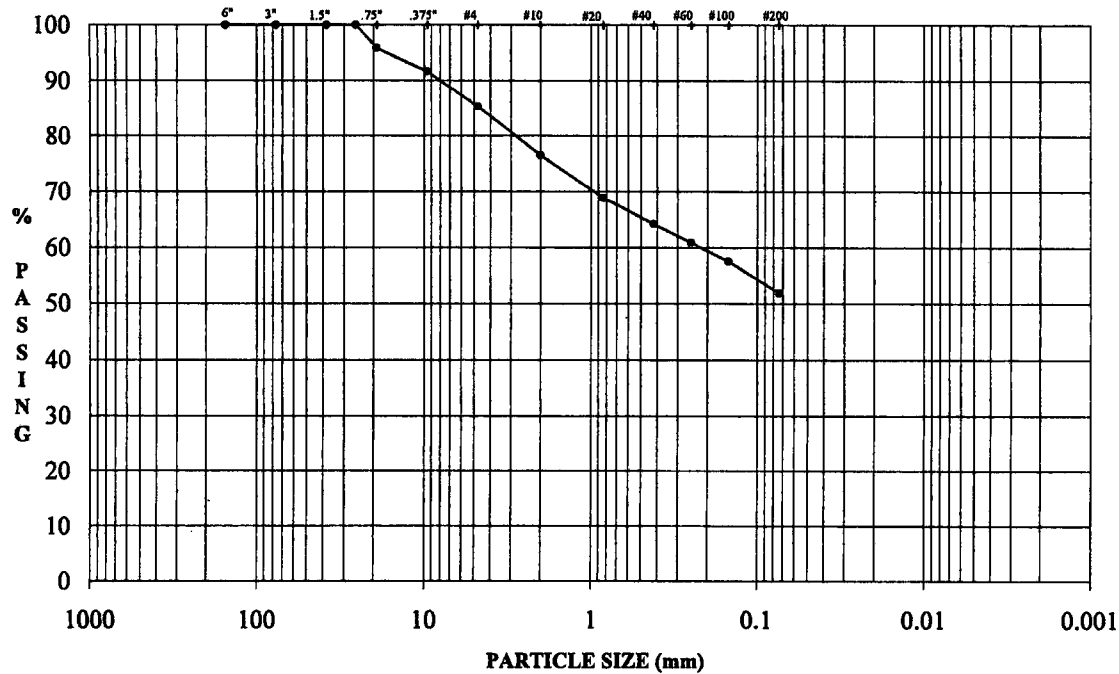
Wet Color: **Brown**
Description: **Clay**

Date: **10/24/05**
Technician: **RDD**
Reviewer: **RMW**

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

PARTICLE-SIZE DISTRIBUTION ASTM D 422
US STANDARD SIEVE OPENING SIZES



Sample Data

% Gravel	14.7
% Sand	33.3
% Fines	52.0
C _c	N/A
C _u	N/A
LL	-
PL	-
PI	-
USCS	-
w (%)	16.5
Percent Finer	
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	95.9%
3/8"	91.6%
#4	85.3%
#10	76.5%
#20	68.9%
#40	64.3%
#60	60.9%
#100	57.6%
#200	52.0%

COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay FINES
	GRAVEL		SAND			

COMMENTS:

DESCRIPTION

Sample: RD-5
S12

Depth: 38'-40'

Wet Color: Brown
Description: Clay with some coarse to fine sand and trace fine gravel

Date: 10/24/05
Technician: RDD
Reviewer: RMW

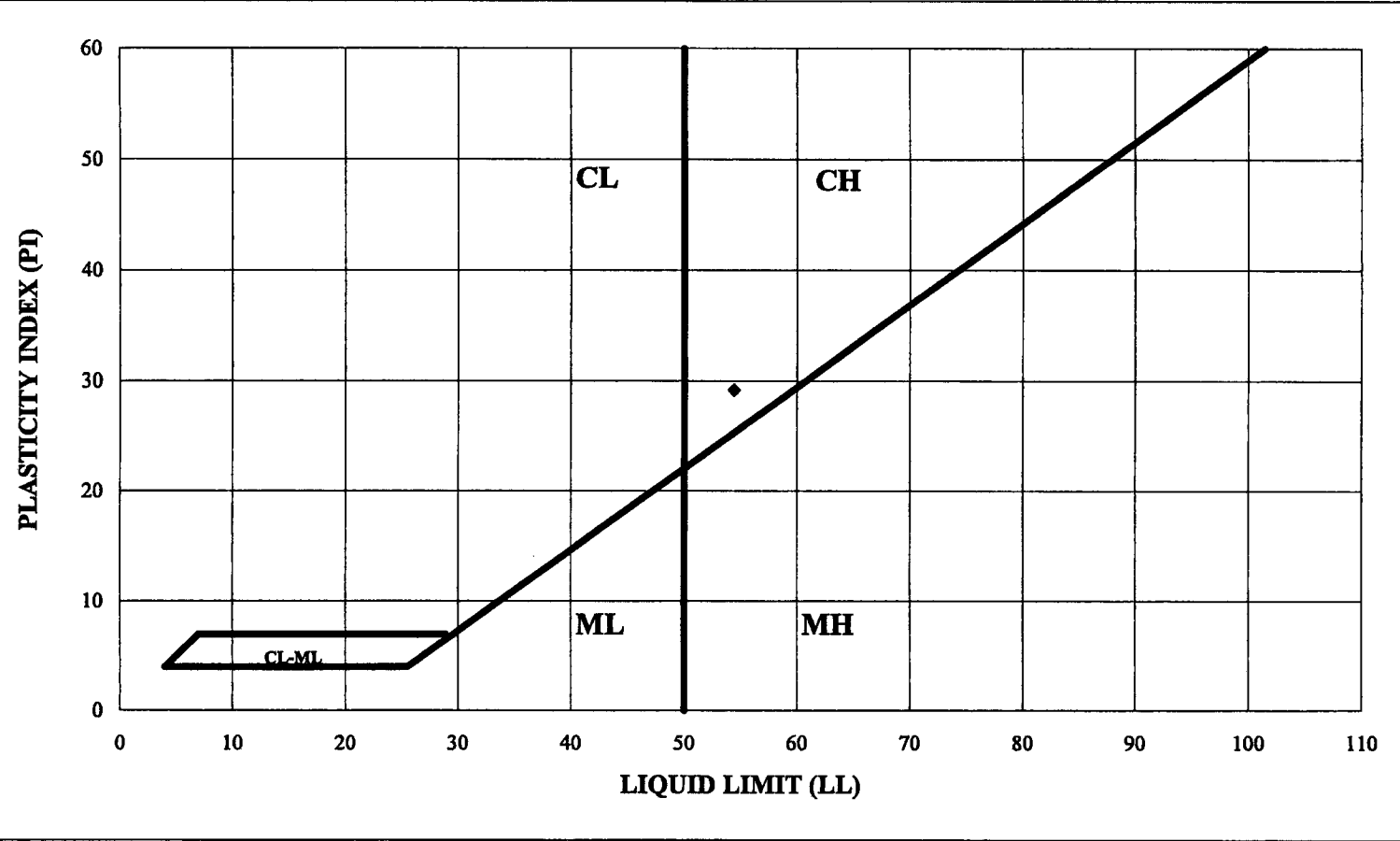
CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

ATTERBERG LIMITS
ASTM D 4318

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				SAMPLE #: RD-1 S4	
				DEPTH: 12'-14'	
SAMPLE PREPARATION Wet or Dry Wet					
PLASTIC LIMIT			DELIVERED MOISTURE CONTENT		
tare #	N6	CH30			
wt soil&tare,moist (g)	41.23	41.79			
wt soil&tare,dry (g)	39.33	39.65			
wt tare (g)	31.76	31.20			
wt moisture (g)	1.90	2.14			
wt dry soil (g)	7.57	8.45			
% moisture	25.10	25.33	AVERAGE		
			25		
tare #			CH036		
wt soil&tare,moist (g)			136.23		
wt soil&tare,dry (g)			110.57		
wt tare (g)			51.13		
wt moisture (g)			25.66		
wt dry soil (g)			59.44		
% moisture			43.17		
LIQUID LIMIT					
Number of Blows	24	23			
tare #	CH24	R1			
wt soil&tare,moist (g)	45.17	43.45			
wt soil&tare,dry (g)	40.25	39.19			
wt tare (g)	31.30	31.39			
wt moisture (g)	4.92	4.26			
wt dry soil (g)	8.95	7.80			
% moisture	54.97	54.62			
LL	54.70	54.07	AVERAGE		
			54		
			LIQUID LIMIT:	54	
			PLASTIC LIMIT:	25	
			PLASTICITY INDEX:	29	
			DELIVERED MOISTURE:	43.17	
			WET COLOR:	Dark grayish brown	
			USCS:	CH	
USCS Classification is based upon material passing the #40 sieve ONLY.					
LL CALCULATION: % moisture*((Number of Blows/25)^0.121))					
				DATE	10/28/05
				TECH	ND
				REVIEW	RMW

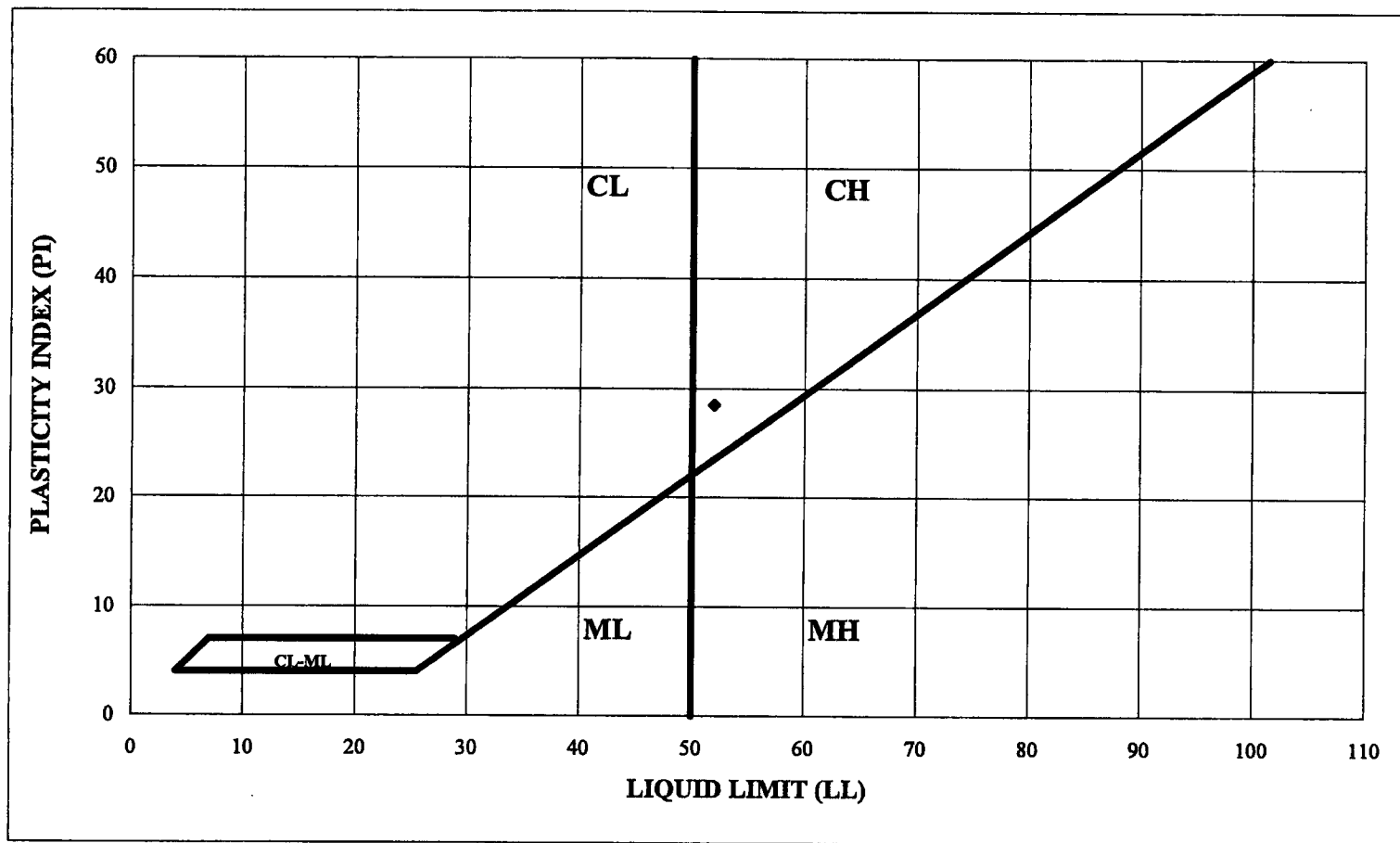
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CHERRY HILL, NEW JERSEY



ATTERBERG LIMITS
ASTM D 4318

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				SAMPLE #: RD-1 S5	
				DEPTH: 16'-18'	
SAMPLE PREPARATION Wet or Dry Wet					
PLASTIC LIMIT			DELIVERED MOISTURE CONTENT		
tare #	20B	28C			
wt soil&tare,moist (g)	32.14	32.23			
wt soil&tare,dry (g)	29.99	30.08			
wt tare (g)	20.89	20.81			
wt moisture (g)	2.15	2.15			
wt dry soil (g)	9.10	9.27			
% moisture	23.63	23.19	AVERAGE		
			23		
			tare #	R23	
			wt soil&tare,moist (g)	152.08	
			wt soil&tare,dry (g)	119.40	
			wt tare (g)	51.99	
			wt moisture (g)	32.68	
			wt dry soil (g)	67.41	
			% moisture	48.48	
LIQUID LIMIT					
Number of Blows	20	20			
tare #	T30	4B			
wt soil&tare,moist (g)	31.28	33.29			
wt soil&tare,dry (g)	27.38	28.95			
wt tare (g)	20.07	20.82			
wt moisture (g)	3.90	4.34			
wt dry soil (g)	7.31	8.13			
% moisture	53.35	53.38			
LL	51.93	51.96	AVERAGE		
			52		
			LIQUID LIMIT:	52	
			PLASTIC LIMIT:	23	
			PLASTICITY INDEX:	29	
			DELIVERED MOISTURE:	48.48	
			WET COLOR:	Dark yellowish brown	
			USCS:	CH	
USCS Classification is based upon material passing the #40 sieve ONLY.					
LL CALCULATION: % moisture*((Number of Blows/25)^0.121))					
				DATE	10/28/05
				TECH	ND
				REVIEW	RMW

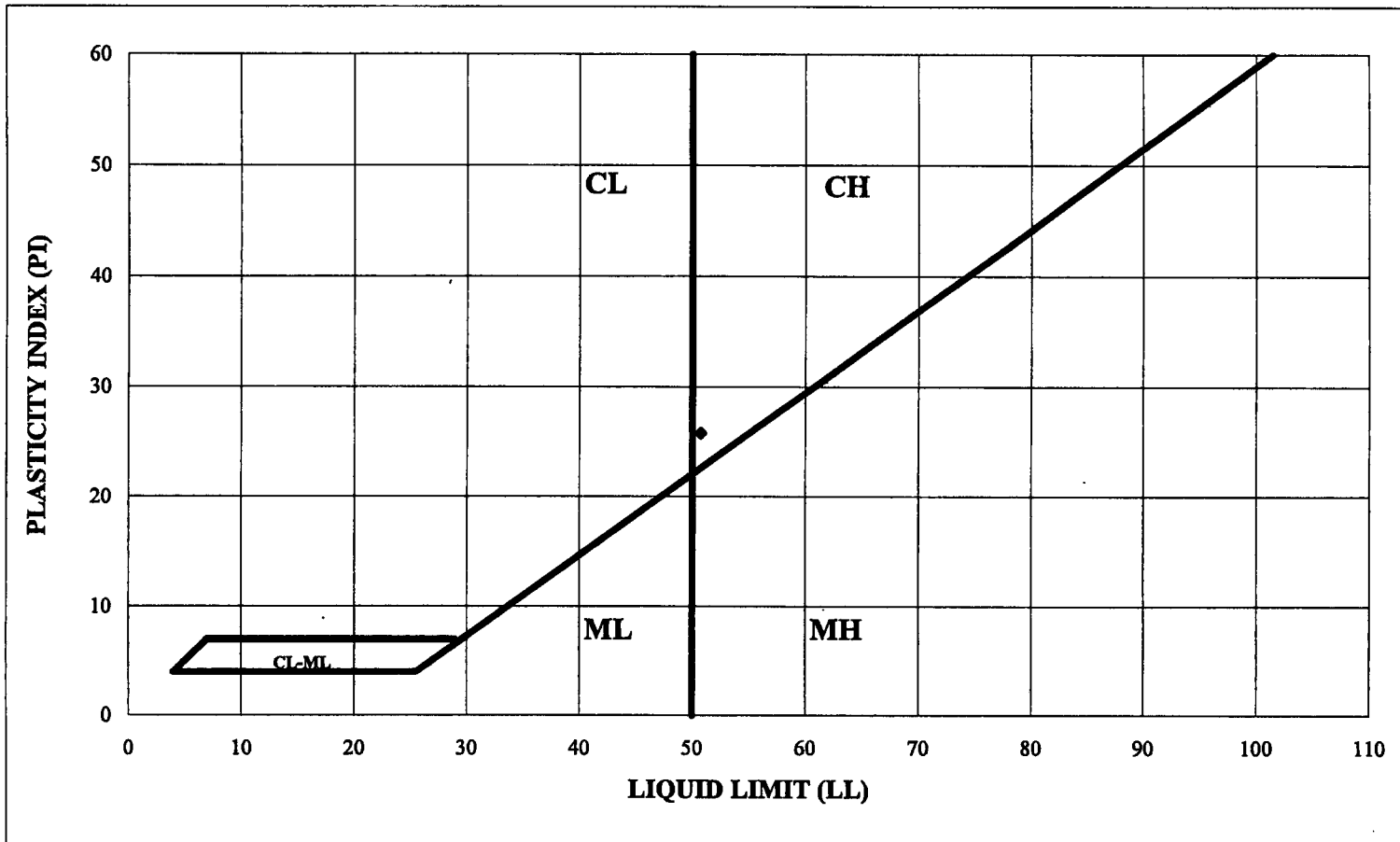
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ATTERBERG LIMITS
ASTM D 4318

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				SAMPLE #: RD-2 S1	
				DEPTH: 9'-11'	
SAMPLE PREPARATION Wet or Dry Wet					
PLASTIC LIMIT			DELIVERED MOISTURE CONTENT		
tare #	CP8	11B			
wt soil&tare,moist (g)	33.20	31.34			
wt soil&tare,dry (g)	30.96	29.26			
wt tare (g)	22.05	20.86			
wt moisture (g)	2.24	2.08			
wt dry soil (g)	8.91	8.40			
% moisture	25.14	24.76	AVERAGE	25	
			tare #	CH024	
			wt soil&tare,moist (g)	144.99	
			wt soil&tare,dry (g)	117.12	
			wt tare (g)	50.67	
			wt moisture (g)	27.87	
			wt dry soil (g)	66.45	
			% moisture	41.94	
LIQUID LIMIT					
Number of Blows	28	29			
tare #	18	27C			
wt soil&tare,moist (g)	34.54	35.03			
wt soil&tare,dry (g)	29.53	30.26			
wt tare (g)	19.53	20.67			
wt moisture (g)	5.01	4.77			
wt dry soil (g)	10.00	9.59			
% moisture	50.10	49.74			
LL	50.79	50.64			
			AVERAGE		
			51		
			LIQUID LIMIT: 51 PLASTIC LIMIT: 25 PLASTICITY INDEX: 26 DELIVERED MOISTURE: 41.94		
			WET COLOR: Dark grayish brown		
			USCS: CH		
USCS Classification is based upon material passing the #40 sieve ONLY.					
LL CALCULATION: % moisture*((Number of Blows/25)^0.121))					
				DATE	10/28/05
				TECH	ND
				REVIEW	RMW

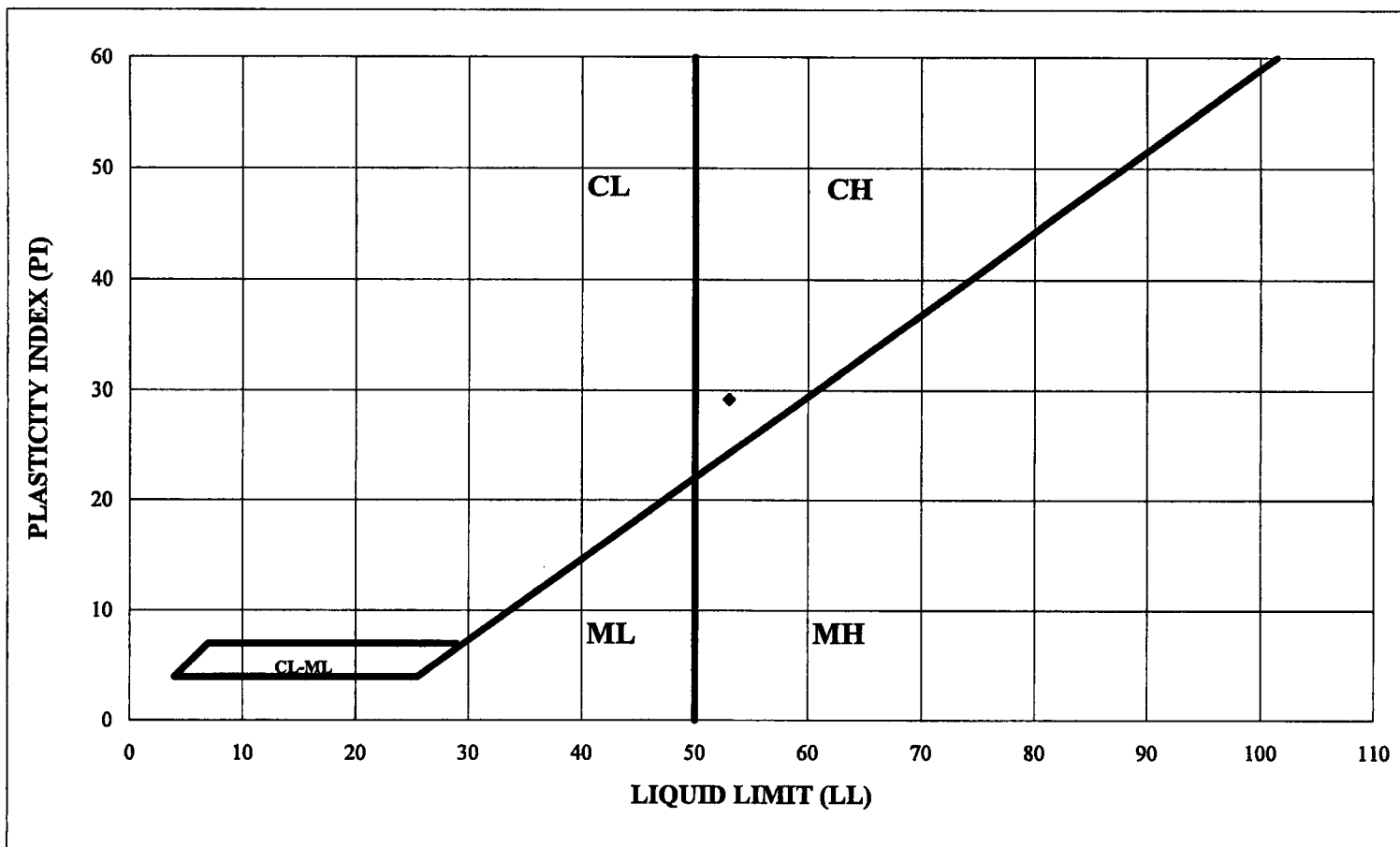
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ATTERBERG LIMITS
ASTM D 4318

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				SAMPLE #: RD-2 S3	
				DEPTH: 15'-17'	
SAMPLE PREPARATION Wet or Dry Wet					
PLASTIC LIMIT			DELIVERED MOISTURE CONTENT		
tare #	X	59			
wt soil&tare,moist (g)	32.64	32.59			
wt soil&tare,dry (g)	30.52	30.39			
wt tare (g)	21.64	21.14			
wt moisture (g)	2.12	2.20			
wt dry soil (g)	8.88	9.25			
% moisture	23.87	23.78	AVERAGE		
			24		
			tare #	R22	
			wt soil&tare,moist (g)	111.39	
			wt soil&tare,dry (g)	92.76	
			wt tare (g)	51.84	
			wt moisture (g)	18.63	
			wt dry soil (g)	40.92	
			% moisture	45.53	
LIQUID LIMIT					
Number of Blows	30	29			
tare #	24E	UNC			
wt soil&tare,moist (g)	33.39	35.40			
wt soil&tare,dry (g)	28.74	30.36			
wt tare (g)	19.80	20.65			
wt moisture (g)	4.65	5.04			
wt dry soil (g)	8.94	9.71			
% moisture	52.01	51.91			
LL	53.17	52.85	AVERAGE		
			53		
			LIQUID LIMIT:	53	
			PLASTIC LIMIT:	24	
			PLASTICITY INDEX:	29	
			DELIVERED MOISTURE:	45.53	
			WET COLOR:	Dark grayish brown	
			USCS:	CH	
USCS Classification is based upon material passing the #40 sieve ONLY.					
LL CALCULATION: % moisture*((Number of Blows/25)^0.121)					
				DATE	10/28/05
				TECH	ND
				REVIEW	RMW

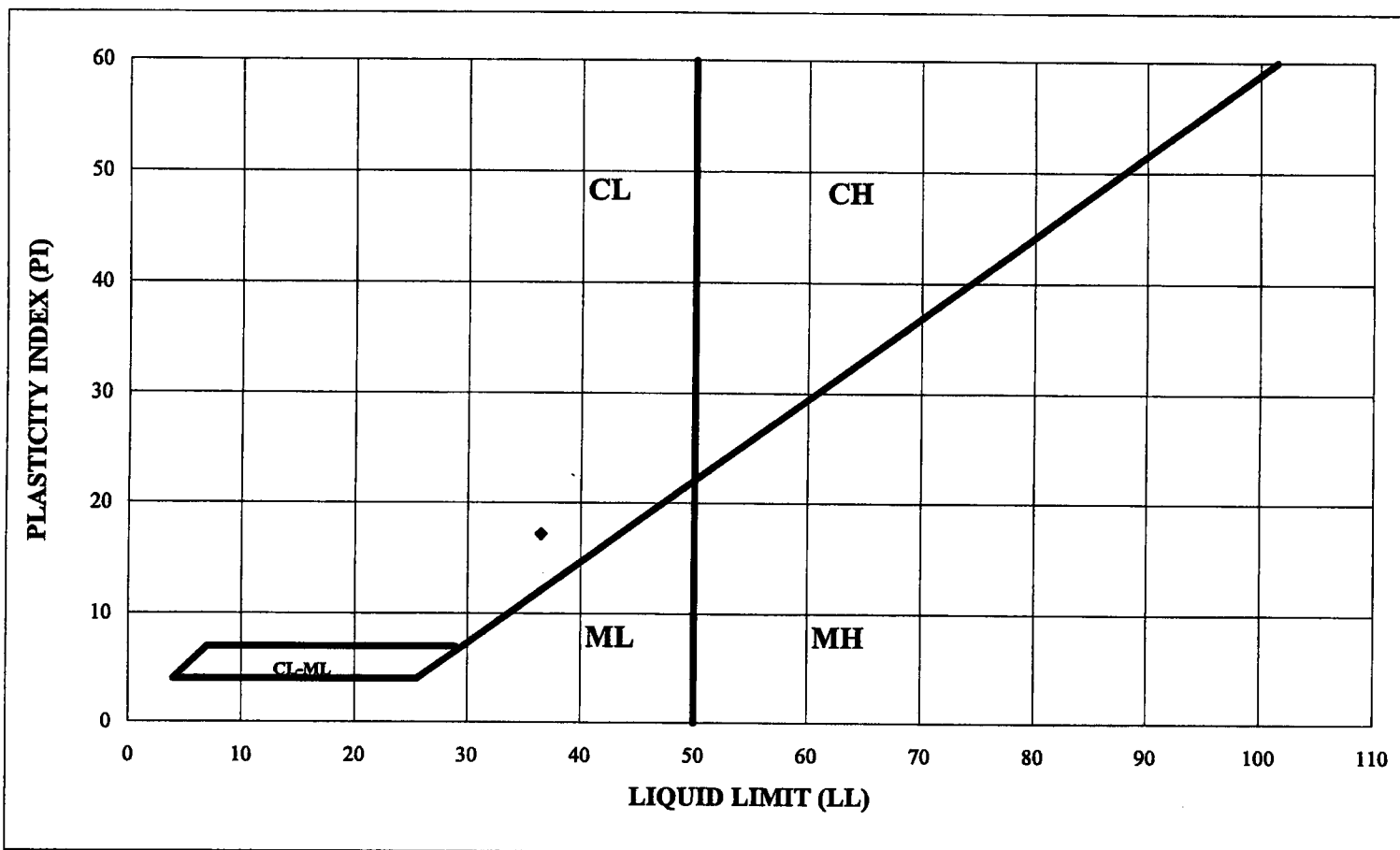
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ATTERBERG LIMITS
ASTM D 4318

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				SAMPLE #: RD-2 ST-4	
				DEPTH: 19'-21'	
SAMPLE PREPARATION Wet or Dry Wet					
PLASTIC LIMIT			DELIVERED MOISTURE CONTENT		
tare #	RR1	C27			
wt soil&tare,moist (g)	29.52	29.32			
wt soil&tare,dry (g)	28.16	28.12			
wt tare (g)	21.26	21.73			
wt moisture (g)	1.36	1.20			
wt dry soil (g)	6.90	6.39	AVERAGE		
% moisture	19.71	18.78	19		
			tare #	CH23	
			wt soil&tare,moist (g)	97.02	
			wt soil&tare,dry (g)	79.84	
			wt tare (g)	31.51	
			wt moisture (g)	17.18	
			wt dry soil (g)	48.33	
			% moisture	35.55	
LIQUID LIMIT					
Number of Blows	22	25			
tare #	34C	CT1			
wt soil&tare,moist (g)	37.53	39.91			
wt soil&tare,dry (g)	32.86	35.02			
wt tare (g)	20.08	21.78			
wt moisture (g)	4.67	4.89			
wt dry soil (g)	12.78	13.24			
% moisture	36.54	36.93	AVERAGE		
LL	35.98	36.93	36		
			LIQUID LIMIT:	36	
			PLASTIC LIMIT:	19	
			PLASTICITY INDEX:	17	
			DELIVERED MOISTURE:	35.55	
			WET COLOR:	Dark brown	
			USCS:	CL	
USCS Classification is based upon material passing the #40 sieve ONLY.					
LL CALCULATION: % moisture*((Number of Blows/25)^0.121))					
				DATE	11/09/05
				TECH	KD
				REVIEW	RMW

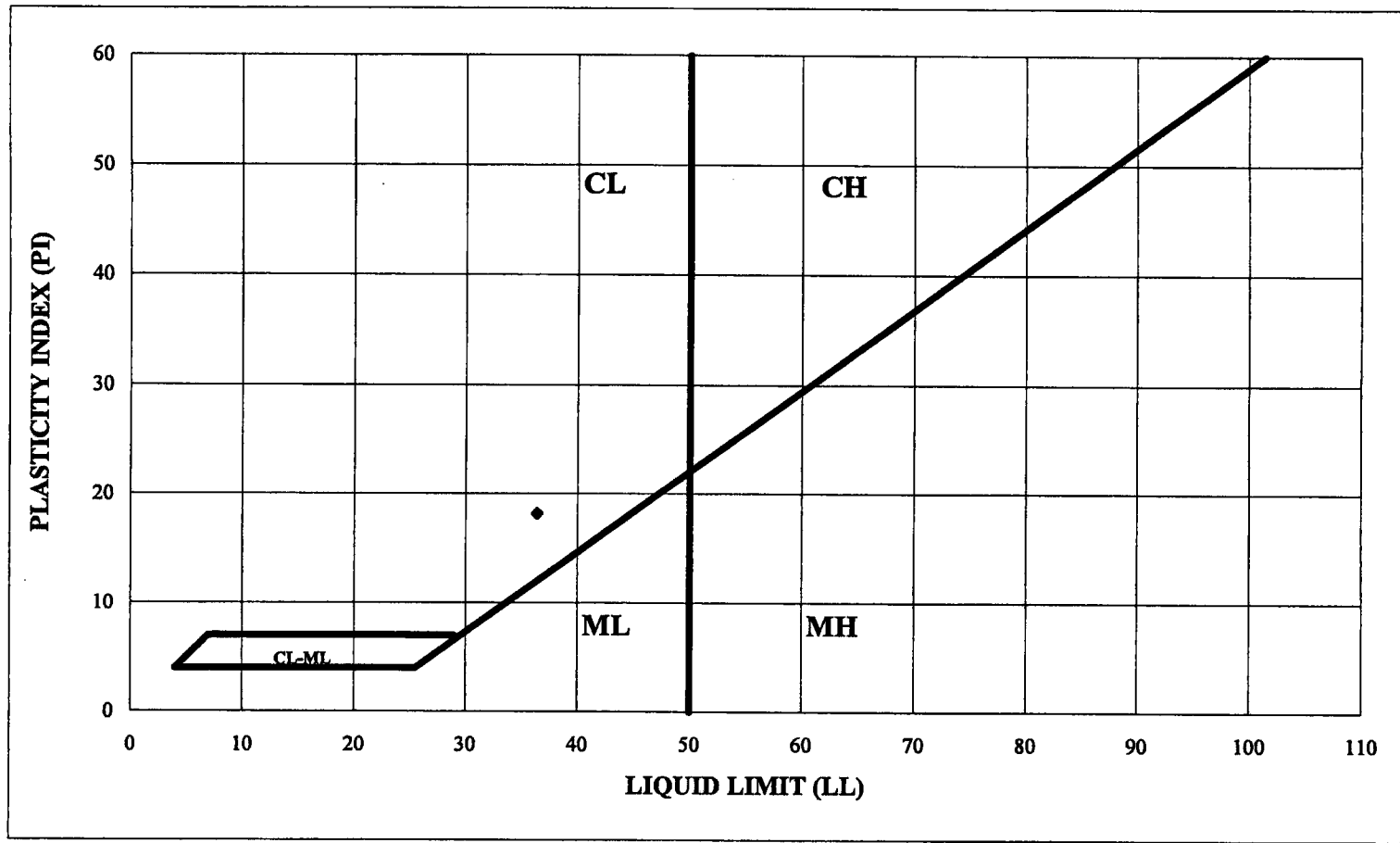
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**ATTERBERG LIMITS
ASTM D 4318**

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				SAMPLE #: RD-3 S2 DEPTH: 10'-12'	
SAMPLE PREPARATION					
Wet or Dry Wet					
PLASTIC LIMIT			DELIVERED MOISTURE CONTENT		
tare #	53	2			
wt soil&tare,moist (g)	37.31	36.17			
wt soil&tare,dry (g)	34.85	34.02			
wt tare (g)	21.33	22.14			
wt moisture (g)	2.46	2.15			
wt dry soil (g)	13.52	11.88			
% moisture	18.20	18.10	AVERAGE		
			18		
			tare # R26 wt soil&tare,moist (g) 152.30 wt soil&tare,dry (g) 128.27 wt tare (g) 50.92 wt moisture (g) 24.03 wt dry soil (g) 77.35 % moisture 31.07		
LIQUID LIMIT					
Number of Blows	28	28			
tare #	M6	23			
wt soil&tare,moist (g)	37.64	36.34			
wt soil&tare,dry (g)	33.55	32.20			
wt tare (g)	22.11	20.69			
wt moisture (g)	4.09	4.14			
wt dry soil (g)	11.44	11.51			
% moisture	35.75	35.97			
LL	36.25	36.47	AVERAGE		
			36		
			LIQUID LIMIT: 36 PLASTIC LIMIT: 18 PLASTICITY INDEX: 18 DELIVERED MOISTURE: 31.07		
			WET COLOR: Dark gray with dark yellowish brown		
			USCS: CL		
USCS Classification is based upon material passing the #40 sieve ONLY. LL CALCULATION: % moisture*((Number of Blows/25)^0.121))					
				DATE	10/28/05
				TECH	ND
				REVIEW	RMW

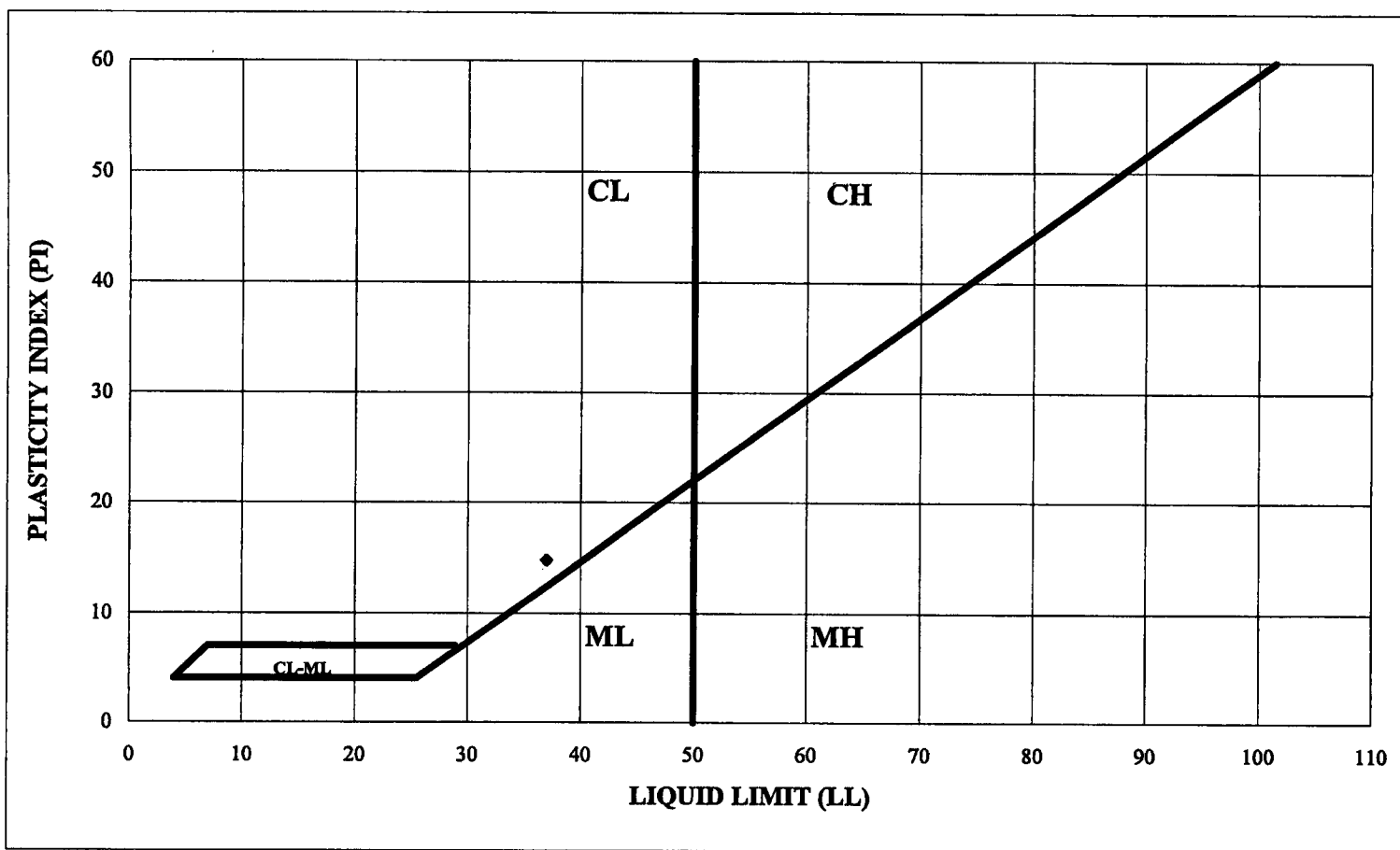
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ATTERBERG LIMITS
ASTM D 4318

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				SAMPLE #: RD-5 S1	
DEPTH: 10'-12'					
SAMPLE PREPARATION Wet or Dry Wet					
PLASTIC LIMIT			DELIVERED MOISTURE CONTENT		
tare #	B7	98			
wt soil&tare,moist (g)	29.77	27.55			
wt soil&tare,dry (g)	28.25	26.08			
wt tare (g)	21.27	19.54			
wt moisture (g)	1.52	1.47			
wt dry soil (g)	6.98	6.54			
% moisture	21.78	22.48	AVERAGE	22	
			tare #	CH023	
			wt soil&tare,moist (g)	128.79	
			wt soil&tare,dry (g)	110.67	
			wt tare (g)	52.17	
			wt moisture (g)	18.12	
			wt dry soil (g)	58.50	
			% moisture	30.97	
LIQUID LIMIT					
Number of Blows	25	29			
tare #	Ch12	CH17			
wt soil&tare,moist (g)	35.46	34.34			
wt soil&tare,dry (g)	31.77	30.94			
wt tare (g)	21.65	21.70			
wt moisture (g)	3.69	3.40			
wt dry soil (g)	10.12	9.24			
% moisture	36.46	36.80	AVERAGE	37	
LL	36.46	37.46			
			LIQUID LIMIT:	37	
			PLASTIC LIMIT:	22	
			PLASTICITY INDEX:	15	
			DELIVERED MOISTURE:	30.97	
			WET COLOR:	Olive brown	
			USCS:	CL	
USCS Classification is based upon material passing the #40 sieve ONLY.					
LL CALCULATION: % moisture*((Number of Blows/25)^0.121))					
				DATE	10/28/05
				TECH	ND
				REVIEW	RMW

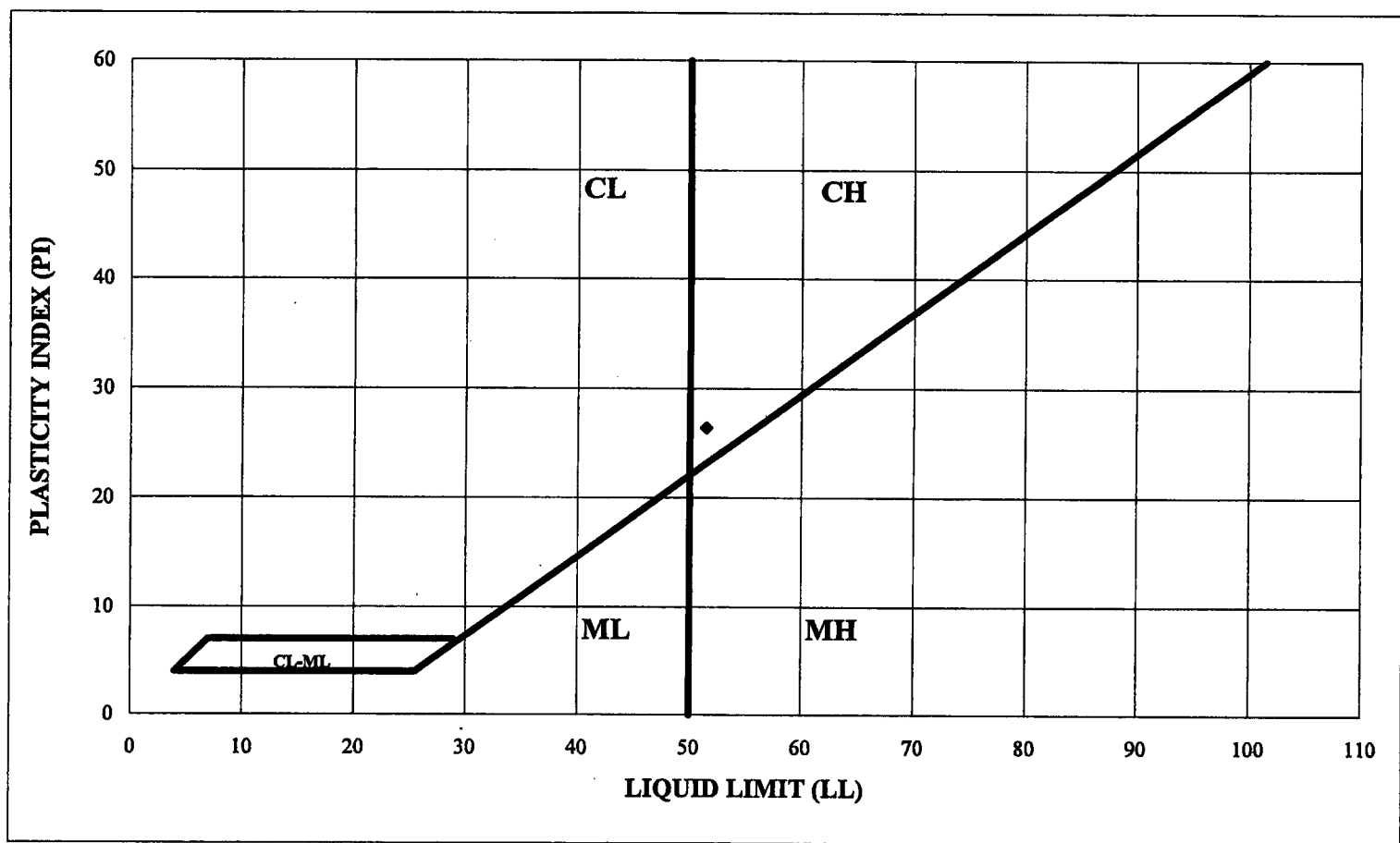
GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY



ATTERBERG LIMITS
ASTM D 4318

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				SAMPLE #: RD-5 S6	
				DEPTH: 24'-26'	
SAMPLE PREPARATION Wet or Dry Wet					
PLASTIC LIMIT			DELIVERED MOISTURE CONTENT		
tare #	Z1	M9			
wt soil&tare,moist (g)	34.02	33.38			
wt soil&tare,dry (g)	31.59	31.01			
wt tare (g)	21.83	21.61			
wt moisture (g)	2.43	2.37			
wt dry soil (g)	9.76	9.40			
% moisture	24.90	25.21	AVERAGE		
			25		
			tare #	F002	
			wt soil&tare,moist (g)	123.22	
			wt soil&tare,dry (g)	98.11	
			wt tare (g)	48.67	
			wt moisture (g)	25.11	
			wt dry soil (g)	49.44	
			% moisture	50.79	
LIQUID LIMIT					
Number of Blows	29	30			
tare #	143	12E			
wt soil&tare,moist (g)	33.76	32.21			
wt soil&tare,dry (g)	29.49	28.17			
wt tare (g)	21.08	20.12			
wt moisture (g)	4.27	4.04			
wt dry soil (g)	8.41	8.05			
% moisture	50.77	50.19			
LL	51.69	51.31	AVERAGE		
			51		
			LIQUID LIMIT:	51	
			PLASTIC LIMIT:	25	
			PLASTICITY INDEX:	26	
			DELIVERED MOISTURE:	50.79	
			WET COLOR:	Dark grayish brown	
			USCS:	CH	
USCS Classification is based upon material passing the #40 sieve ONLY.					
LL CALCULATION: % moisture*((Number of Blows/25)^0.121))					
				DATE	10/28/05
				TECH	ND
				REVIEW	RMW

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

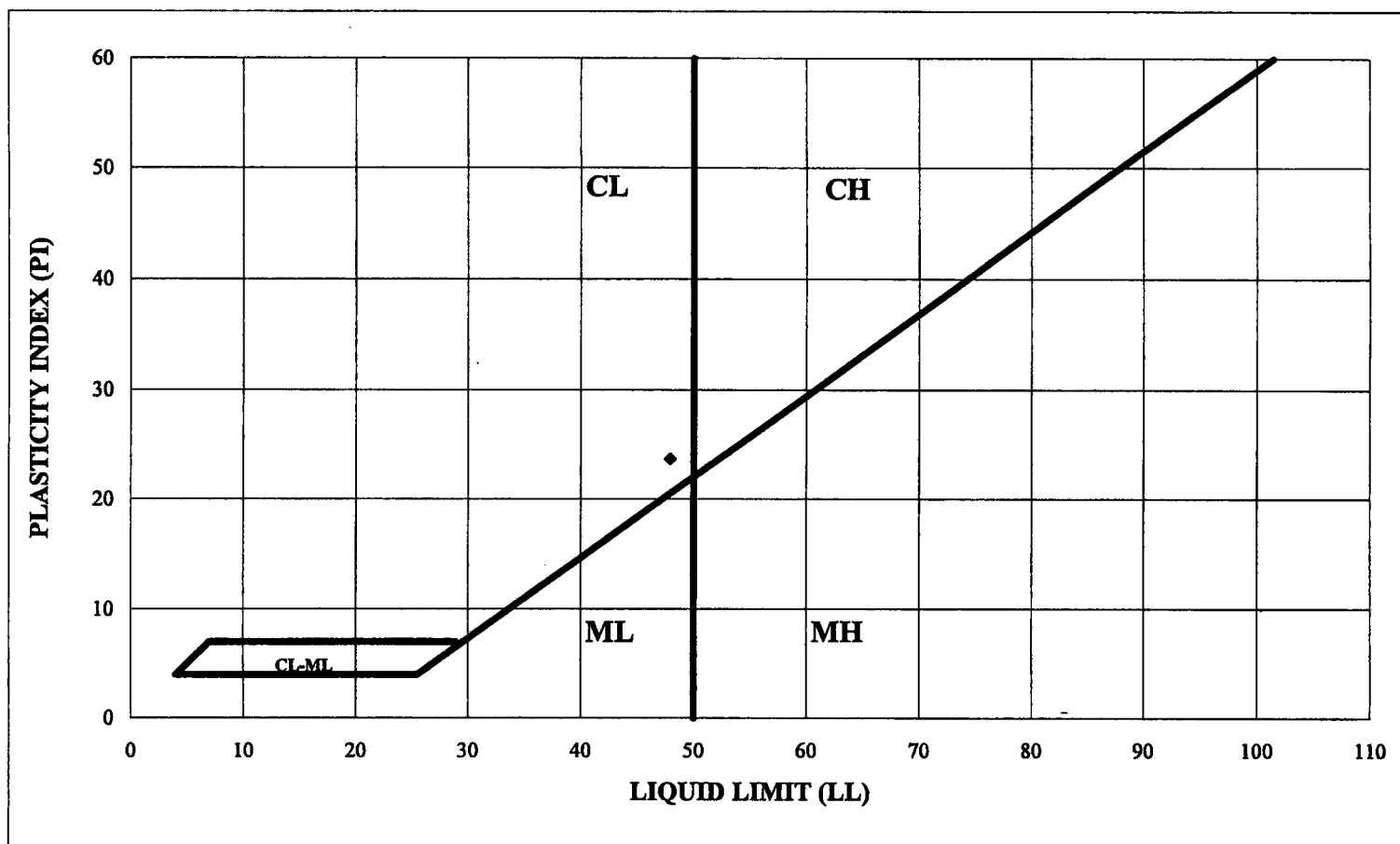


ATTERBERG LIMITS

ASTM D 4318

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				SAMPLE #: RD-5 S8	
				DEPTH: 30'-32'	
SAMPLE PREPARATION Wet or Dry Wet					
PLASTIC LIMIT			DELIVERED MOISTURE CONTENT		
tare #	47	34C			
wt soil&tare,moist (g)	32.32	32.64			
wt soil&tare,dry (g)	30.10	30.20			
wt tare (g)	20.87	20.16			
wt moisture (g)	2.22	2.44			
wt dry soil (g)	9.23	10.04			
% moisture	24.05	24.30	AVERAGE		
			24		
			tare #	CH011	
			wt soil&tare,moist (g)	130.54	
			wt soil&tare,dry (g)	109.90	
			wt tare (g)	52.09	
			wt moisture (g)	20.64	
			wt dry soil (g)	57.81	
			% moisture	35.70	
LIQUID LIMIT					
Number of Blows	20	20			
tare #	CH19	1			
wt soil&tare,moist (g)	35.09	33.69			
wt soil&tare,dry (g)	30.58	29.30			
wt tare (g)	21.38	20.41			
wt moisture (g)	4.51	4.39			
wt dry soil (g)	9.20	8.89			
% moisture	49.02	49.38			
LL	47.72	48.07	AVERAGE		
			48		
			LIQUID LIMIT:	48	
			PLASTIC LIMIT:	24	
			PLASTICITY INDEX:	24	
			DELIVERED MOISTURE:	35.70	
			WET COLOR:	Dark yellowish brown	
			USCS:	CL	
USCS Classification is based upon material passing the #40 sieve ONLY.					
LL CALCULATION: % moisture*((Number of Blows/25)^0.121))					
				DATE	10/28/05
				TECH	ND
				REVIEW	RMW

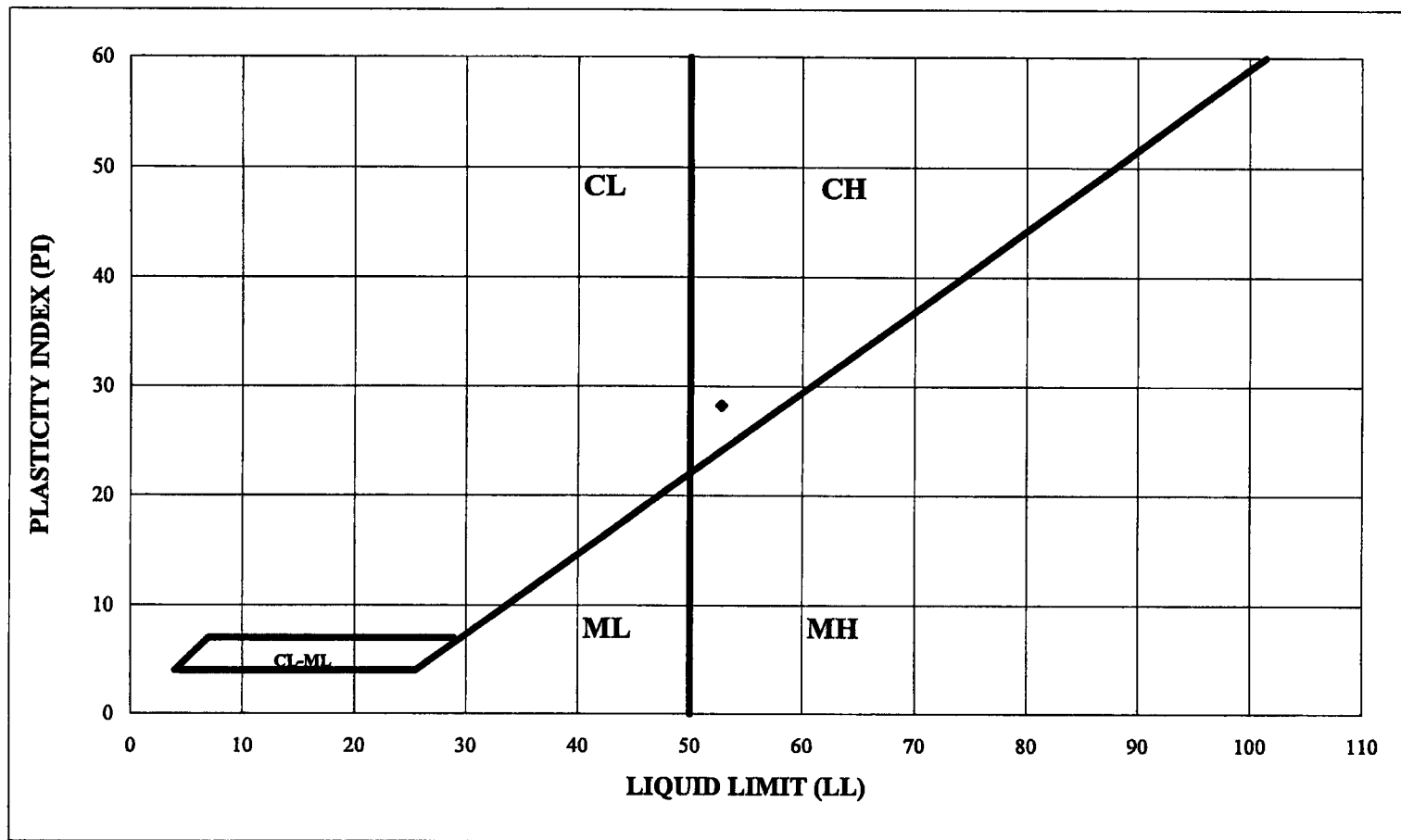
GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY



**ATTERBERG LIMITS
ASTM D 4318**

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				SAMPLE #: RD-5 ST-4	
				DEPTH: 16'-18'	
SAMPLE PREPARATION Wet or Dry Wet					
PLASTIC LIMIT			DELIVERED MOISTURE CONTENT		
tare #	46	13B			
wt soil&tare,moist (g)	31.39	29.94			
wt soil&tare,dry (g)	29.26	27.92			
wt tare (g)	20.50	19.75			
wt moisture (g)	2.13	2.02			
wt dry soil (g)	8.76	8.17			
% moisture	24.32	24.72	AVERAGE		
			25		
tare #			tare #	N2	
wt soil&tare,moist (g)			wt soil&tare,moist (g)	99.09	
wt soil&tare,dry (g)			wt soil&tare,dry (g)	78.56	
wt tare (g)			wt tare (g)	31.77	
wt moisture (g)			wt moisture (g)	20.53	
wt dry soil (g)			wt dry soil (g)	46.79	
% moisture			% moisture	43.88	
LIQUID LIMIT					
Number of Blows	30	30			
tare #	CP4	CH10			
wt soil&tare,moist (g)	36.24	35.35			
wt soil&tare,dry (g)	31.11	30.71			
wt tare (g)	21.20	21.69			
wt moisture (g)	5.13	4.64			
wt dry soil (g)	9.91	9.02			
% moisture	51.77	51.44			
LL	52.92	52.59	AVERAGE		
			53		
			LIQUID LIMIT: 53		
			PLASTIC LIMIT: 25		
			PLASTICITY INDEX: 28		
			DELIVERED MOISTURE: 43.88		
			WET COLOR: Dark gray		
			USCS: CH		
USCS Classification is based upon material passing the #40 sieve ONLY.					
LL CALCULATION: % moisture*((Number of Blows/25)^0.121))					
				DATE	10/28/05
				TECH	ND
				REVIEW	RMW

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY



ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300	RD-1 ST-2 14'-16'	DATE 10/7/2005
		TECH RMW/ND
		REVIEW RMW

SAMPLE DATA, GENERAL

height (in)	0.750
diameter (in)	2.500
area (in ²)	4.909
volume (in ³)	3.682
specimen weight, wet (g)	105.53
specimen weight, dry (g)	71.21
water weight (g)	34.32

SAMPLE DATA, INITIAL

total height (in)	0.750
height of solids (in)	0.312
height of voids (in)	0.438
height of water (in)	0.426
void ratio	1.407
% saturation	97.26%
dry density (pcf)	73.68
moist density (pcf)	109.20

SAMPLE DATA, FINAL

total height (in)	0.591
height of solids (in)	0.312
height of voids (in)	0.280
height of water (in)	0.349
void ratio	0.898
% saturation	124.62%
dry density (pcf)	93.46
moist density (pcf)	130.29

DESCRIPTION

LL:
PL:
PI:
Gs: 2.84

MOISTURE CONTENT, INITIAL

tare #	N3
wt soil&tare, moist	60.07
wt soil&tare, dry	51.00
wt tare	31.14
wt moisture	9.07
wt dry soil	19.86
% moisture	45.67%

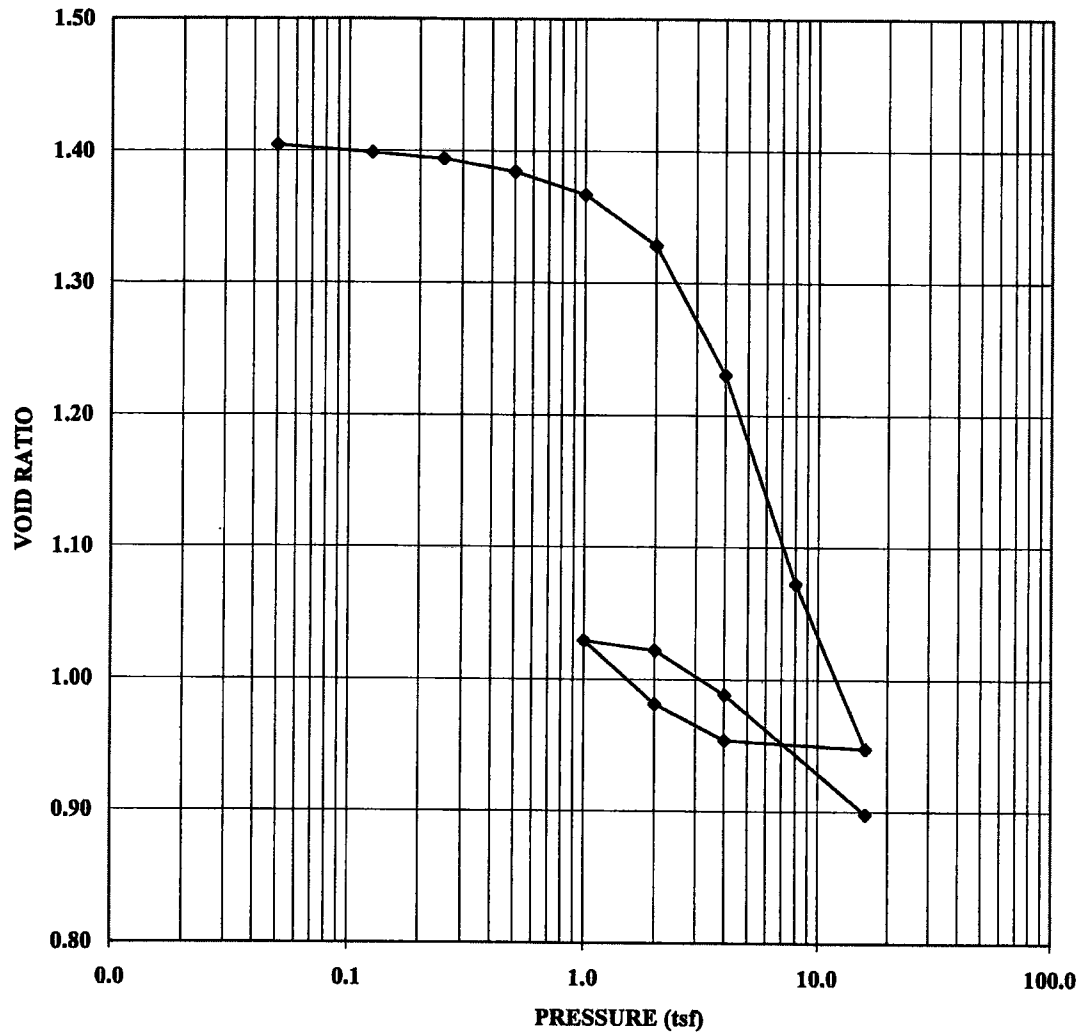
MOISTURE CONTENT, FINAL

tare #	94
wt soil&tare, moist	429.98
wt soil&tare, dry	401.92
wt tare	330.71
wt moisture	28.06
wt dry soil	71.21
% moisture	39.40%

PRESSURE (tsf)	R ₉₀ DIAL READING	DIAL CHANGE (in)	FITTING TIME (sec) t ₉₀	SPECIMEN HEIGHT (in)	HEIGHT OF VOIDS H _v	VOID RATIO e	CHANGE IN HEIGHT (cumulative)	STRAIN %	DRAINAGE PATH (DOUBLE DRAINAGE)		COEFFICIENT OF CONSOLIDATION	
									H (in)	H ² (cm ²)	C _v (cm ² /sec)	(ft ² /day)
0.000	0.0588	0.0000	0	0.7500	0.4385	1.4074	0.0000	0.0000	0.0000	0.0000	0.00E+00	0.00E+00
0.050	0.0598	0.0010	73	0.7490	0.4374	1.4041	0.0010	0.0014	0.3453	0.7692	8.91E-03	8.28E-01
0.125	0.0615	0.0017	397	0.7473	0.4357	1.3986	0.0027	0.0036	0.3445	0.7657	1.64E-03	1.52E-01
0.250	0.0630	0.0014	275	0.7459	0.4343	1.3940	0.0042	0.0055	0.3437	0.7619	2.35E-03	2.18E-01
0.500	0.0661	0.0031	122	0.7427	0.4312	1.3841	0.0073	0.0097	0.3423	0.7559	5.24E-03	4.87E-01
1.000	0.0714	0.0054	122	0.7374	0.4258	1.3669	0.0126	0.0168	0.3401	0.7460	5.17E-03	4.81E-01
2.000	0.0835	0.0120	313	0.7254	0.4138	1.3282	0.0247	0.0329	0.3354	0.7255	1.96E-03	1.83E-01
4.000	0.1139	0.0305	313	0.6949	0.3834	1.2305	0.0551	0.0735	0.3231	0.6733	1.82E-03	1.69E-01
8.000	0.1631	0.0492	490	0.6457	0.3342	1.0726	0.1043	0.1391	0.3013	0.5855	1.01E-03	9.43E-02
16.000	0.2020	0.0389	240	0.6068	0.2953	0.9477	0.1432	0.1909	0.2802	0.5065	1.79E-03	1.66E-01
4.000	0.2000	-0.0020	275	0.6088	0.2973	0.9541	0.1412	0.1883	0.2735	0.4824	1.49E-03	1.38E-01
2.000	0.1915	-0.0085	354	0.6173	0.3058	0.9814	0.1327	0.1769	0.2778	0.4979	1.19E-03	1.11E-01
1.000	0.1766	-0.0149	648	0.6322	0.3207	1.0293	0.1178	0.1571	0.2840	0.5202	6.81E-04	6.33E-02
2.000	0.1789	0.0023	240	0.6299	0.3184	1.0219	0.1201	0.1601	0.2868	0.5305	1.87E-03	1.74E-01
4.000	0.1893	0.0104	397	0.6195	0.3080	0.9885	0.1305	0.1740	0.2820	0.5131	1.10E-03	1.02E-01
16.000	0.2175	0.0282	176	0.5913	0.2798	0.8980	0.1587	0.2116	0.2714	0.4752	2.28E-03	2.12E-01

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

ONE-DIMENSIONAL CONSOLIDATION



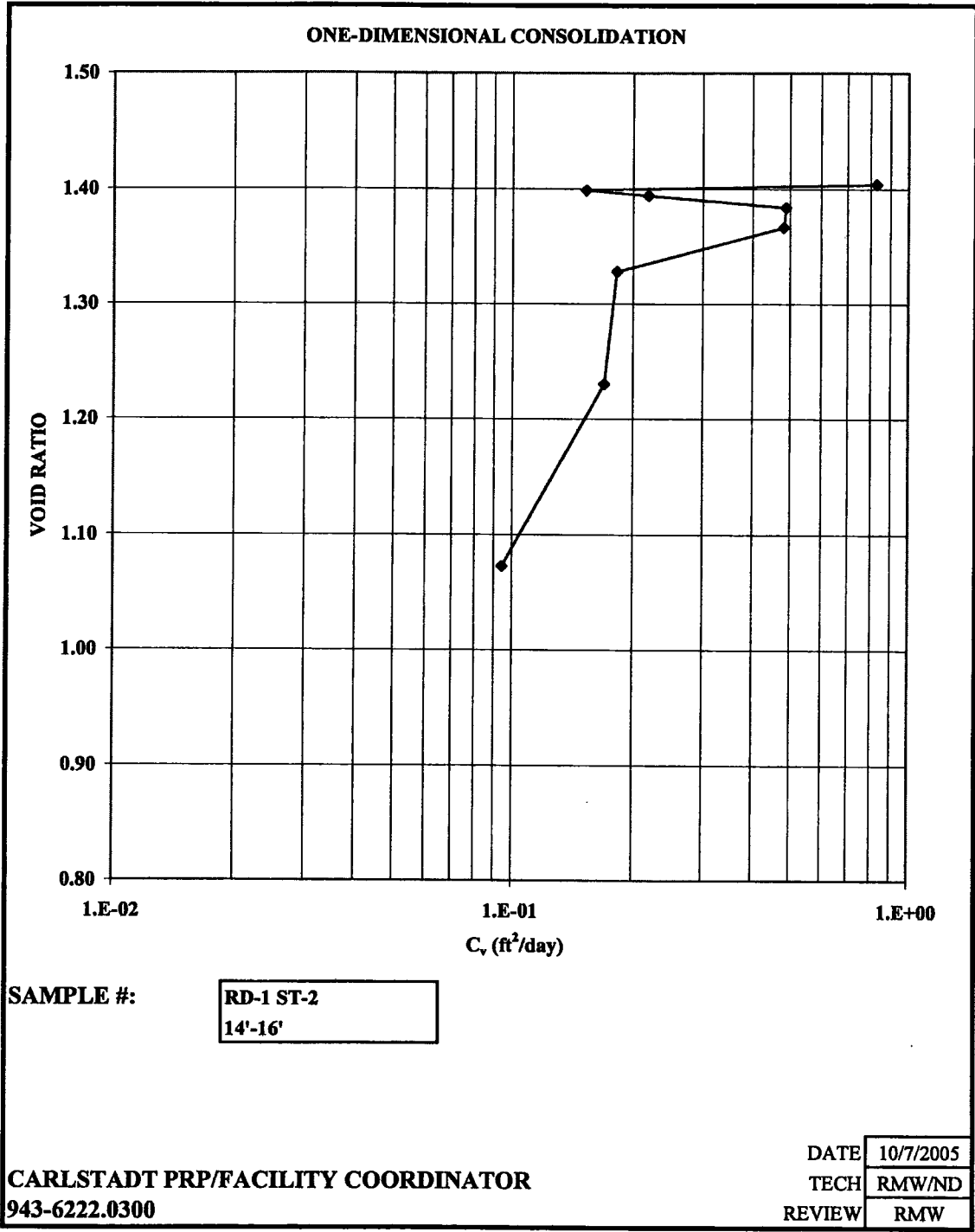
SAMPLE #:

RD-1 ST-2
14'-16'

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

DATE	10/7/2005
TECH	RMW/ND
REVIEW	RMW



ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

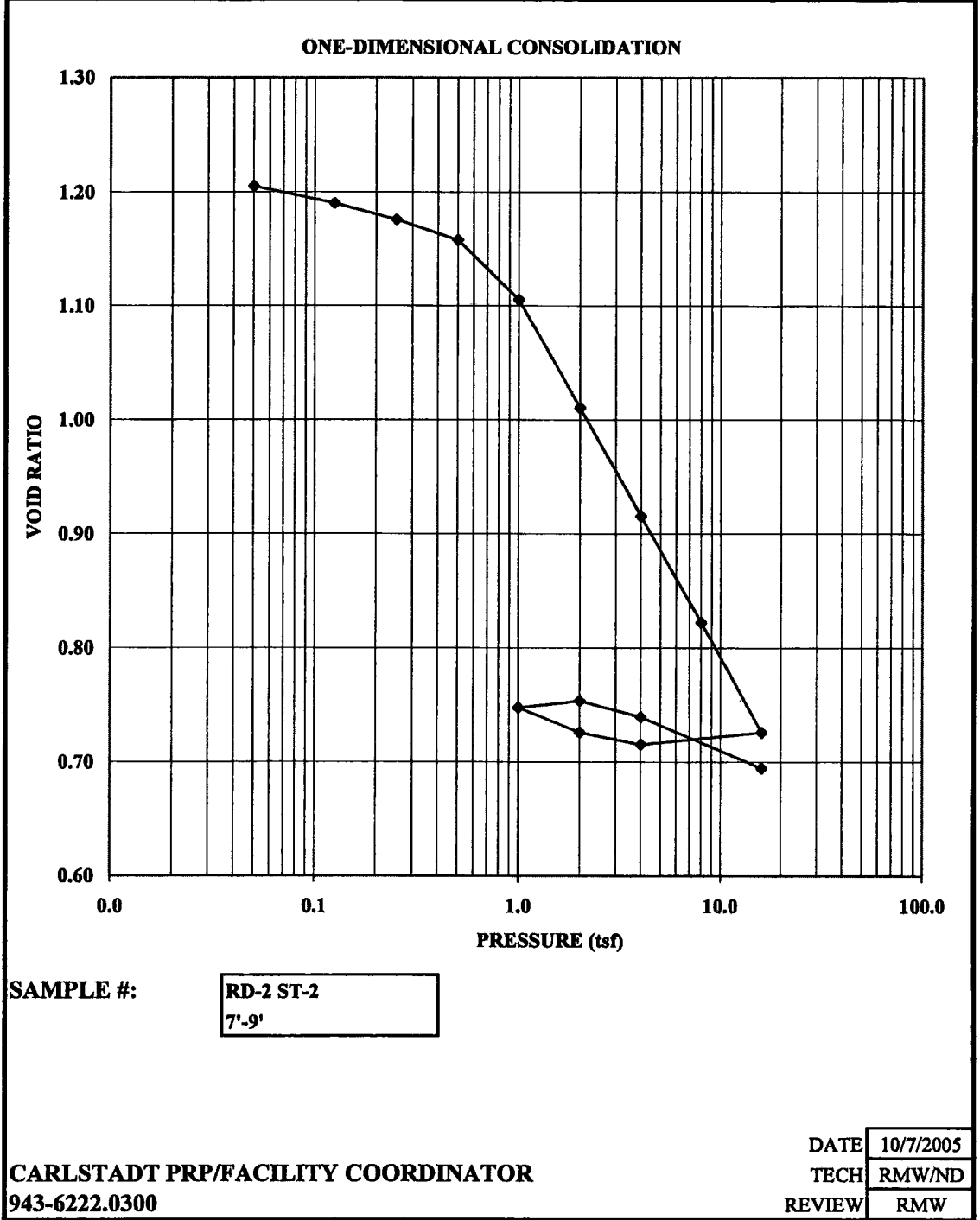
CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				RD-2 ST-2 7'-9'				DATE 10/7/2005 TECH RMW/ND REVIEW RMW			
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SAMPLE DATA, GENERAL				SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL			
height (in)	0.750	total height (in)	0.750	total height (in)	0.572						
diameter (in)	2.500	height of solids (in)	0.337	height of solids (in)	0.337						
area (in ²)	4.909	height of voids (in)	0.413	height of voids (in)	0.234						
volume (in ³)	3.682	height of water (in)	0.392	height of water (in)	0.289						
specimen weight, wet (g)	101.58	void ratio	1.224	void ratio	0.695						
specimen weight, dry (g)	70.02	% saturation	95.00%	% saturation	123.25%						
water weight (g)	31.56	dry density (pcf)	72.45	dry density (pcf)	95.08						
		moist density (pcf)	105.11	moist density (pcf)	126.64						

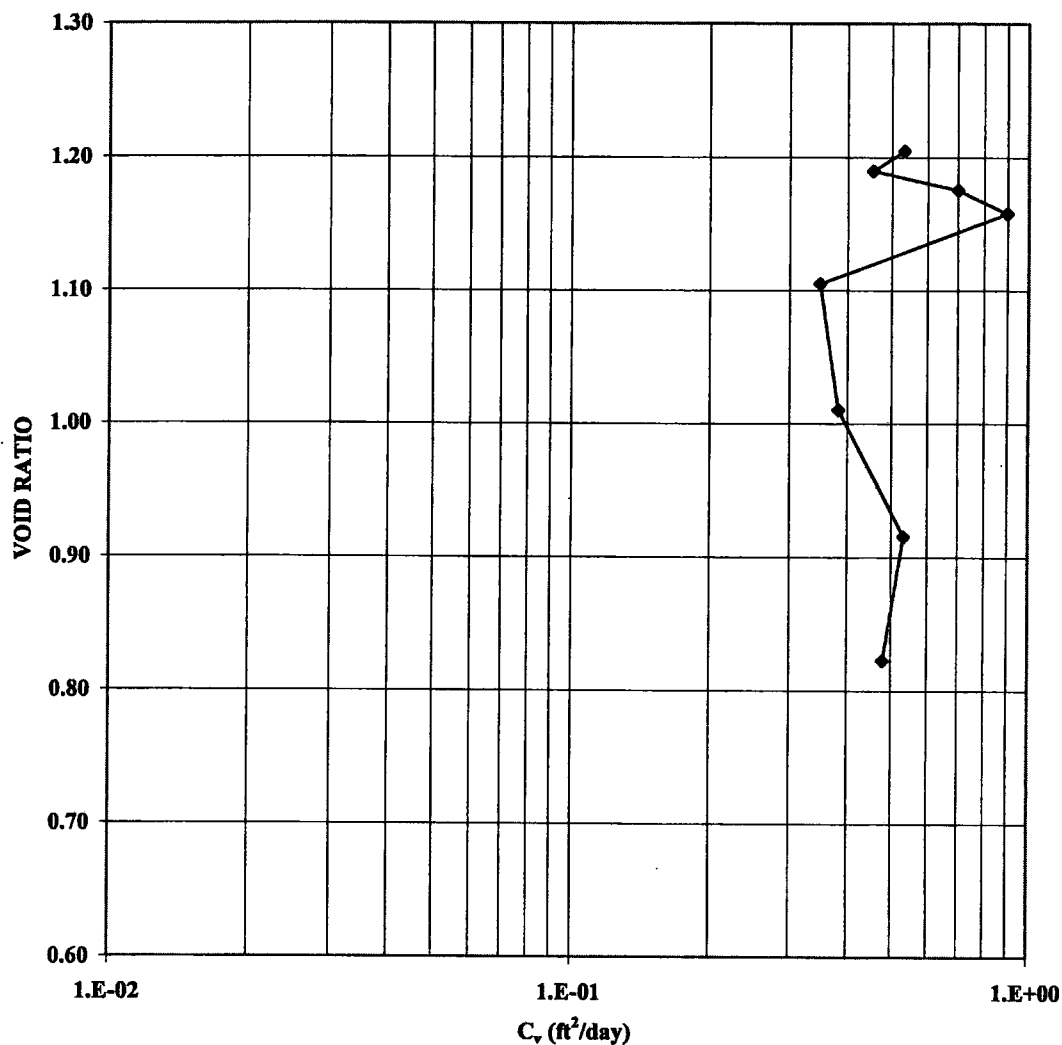
DESCRIPTION		MOISTURE CONTENT, INITIAL		MOISTURE CONTENT, FINAL	
		tare #	CH23	tare #	91
		wt soil&tare,moist	97.02	wt soil&tare,moist	431.14
		wt soil&tare,dry	79.84	wt soil&tare,dry	407.90
		wt tare	31.51	wt tare	337.88
		wt moisture	17.18	wt moisture	23.24
LL:		wt dry soil	48.33	wt dry soil	70.02
PL:		% moisture	35.55%	% moisture	33.19%
PI:					
Gs:	2.58				

PRESSURE (tsf)	R ₉₀ DIAL READING	DIAL CHANGE (in)	FITTING TIME (sec) t ₉₀	SPECIMEN HEIGHT (in)	HEIGHT OF VOIDS H _v	VOID RATIO e	CHANGE IN HEIGHT (cumulative)	STRAIN %	DRAINAGE PATH (DOUBLE DRAINAGE)		COEFFICIENT OF CONSOLIDATION	
									H (in)	H ² (cm ²)	C _v (cm ² /sec)	(ft ² /day)
0.000	0.0781	0.0000	0	0.7500	0.4128	1.2241	0.0000	0.0000	0.0000	0.0000	0.00E+00	0.00E+00
0.050	0.0846	0.0065	107	0.7435	0.4063	1.2050	0.0065	0.0086	0.3342	0.7204	5.72E-03	5.32E-01
0.125	0.0896	0.0050	122	0.7385	0.4013	1.1900	0.0115	0.0153	0.3307	0.7053	4.89E-03	4.54E-01
0.250	0.0944	0.0048	78	0.7337	0.3965	1.1758	0.0163	0.0217	0.3283	0.6951	7.52E-03	6.99E-01
0.500	0.1004	0.0060	60	0.7277	0.3905	1.1580	0.0223	0.0298	0.3254	0.6829	9.65E-03	8.97E-01
1.000	0.1183	0.0178	148	0.7099	0.3726	1.1051	0.0402	0.0535	0.3190	0.6565	3.76E-03	3.49E-01
2.000	0.1501	0.0319	122	0.6780	0.3408	1.0106	0.0720	0.0960	0.3036	0.5947	4.12E-03	3.83E-01
4.000	0.1823	0.0322	79	0.6459	0.3086	0.9153	0.1042	0.1389	0.2865	0.5296	5.71E-03	5.31E-01
8.000	0.2135	0.0313	78	0.6146	0.2774	0.8226	0.1354	0.1805	0.2717	0.4763	5.15E-03	4.79E-01
16.000	0.2460	0.0325	110	0.5821	0.2449	0.7262	0.1679	0.2239	0.2559	0.4225	3.25E-03	3.02E-01
4.000	0.2496	0.0036	79	0.5785	0.2413	0.7156	0.1715	0.2287	0.2499	0.4027	4.35E-03	4.04E-01
2.000	0.2460	-0.0036	176	0.5821	0.2449	0.7262	0.1679	0.2239	0.2516	0.4084	1.96E-03	1.83E-01
1.000	0.2387	-0.0073	176	0.5894	0.2522	0.7479	0.1606	0.2141	0.2547	0.4184	2.01E-03	1.87E-01
2.000	0.2368	-0.0020	110	0.5914	0.2541	0.7537	0.1587	0.2115	0.2571	0.4265	3.28E-03	3.05E-01
4.000	0.2415	0.0048	88	0.5866	0.2494	0.7396	0.1634	0.2179	0.2548	0.4187	4.03E-03	3.74E-01
16.000	0.2566	0.0151	88	0.5715	0.2343	0.6948	0.1785	0.2380	0.2481	0.3971	3.82E-03	3.55E-01

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY



ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #:

RD-2 ST-2

7'-9'

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

DATE	10/7/2005
TECH	RMW/ND
REVIEW	RMW

ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				RD-3 ST-3 18'-20'				DATE 10/7/2005 TECH RMW/ND REVIEW RMW			
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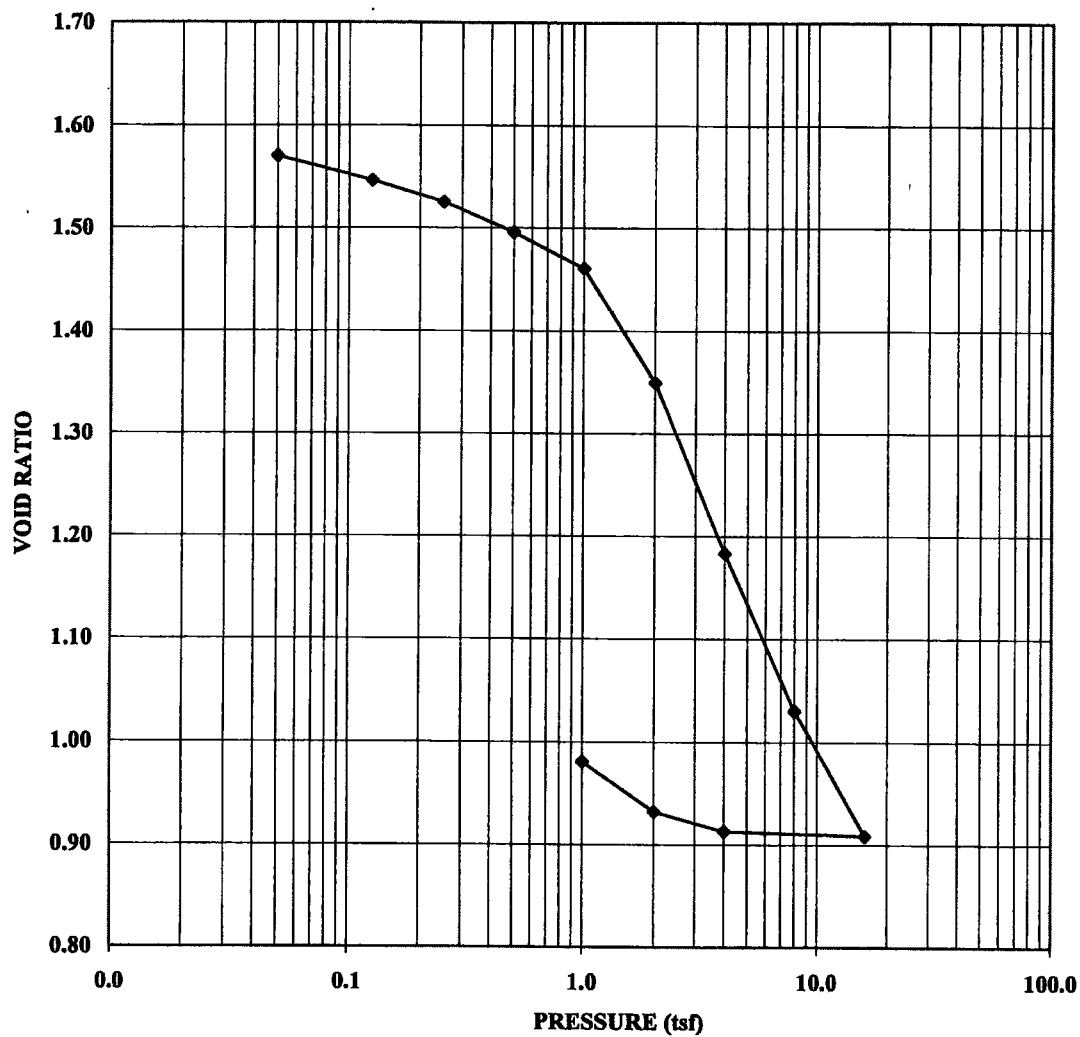
SAMPLE DATA, GENERAL				SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL			
height (in)	0.750	total height (in)	0.750	total height (in)	0.575						
diameter (in)	2.500	height of solids (in)	0.290	height of solids (in)	0.290						
area (in ²)	4.909	height of voids (in)	0.460	height of voids (in)	0.285						
volume (in ³)	3.682	height of water (in)	0.458	height of water (in)	0.330						
specimen weight, wet (g)	102.80	void ratio	1.582	void ratio	0.980						
specimen weight, dry (g)	65.93	% saturation	99.70%	% saturation	115.69%						
water weight (g)	36.87	dry density (pcf)	68.22	dry density (pcf)	88.94						
		moist density (pcf)	106.37	moist density (pcf)	124.71						

DESCRIPTION		MOISTURE CONTENT, INITIAL		MOISTURE CONTENT, FINAL	
		tare #	F002	tare #	20
		wt soil&tare,moist	111.98	wt soil&tare,moist	436.79
		wt soil&tare,dry	91.26	wt soil&tare,dry	410.27
		wt tare	48.79	wt tare	344.34
		wt moisture	20.72	wt moisture	26.52
LL:		wt dry soil	42.47	wt dry soil	65.93
PL:		% moisture	48.79%	% moisture	40.22%
PI:					
Gs:	2.82				

PRESSURE (tsf)	R ₉₀ DIAL READING	DIAL CHANGE (in)	FITTING TIME (sec) t ₉₀	SPECIMEN HEIGHT (in)	HEIGHT OF VOIDS H _v	VOID RATIO e	CHANGE IN HEIGHT (cumulative)	STRAIN %	DRAINAGE PATH (DOUBLE DRAINAGE)		COEFFICIENT OF CONSOLIDATION	
									H (in)	H' (cm ²)	C _v (cm ² /sec)	(ft ² /day)
0.000	0.2321	0.0000	0	0.7500	0.4595	1.5819	0.0000	0.0000	0.0000	0.0000	0.00E+00	0.00E+00
0.050	0.2355	0.0034	96	0.7466	0.4561	1.5701	0.0034	0.0045	0.2580	0.4294	3.79E-03	3.53E-01
0.125	0.2423	0.0068	176	0.7398	0.4493	1.5467	0.0102	0.0136	0.2545	0.4179	2.01E-03	1.87E-01
0.250	0.2485	0.0062	207	0.7336	0.4431	1.5254	0.0164	0.0219	0.2510	0.4065	1.67E-03	1.55E-01
0.500	0.2570	0.0085	207	0.7251	0.4346	1.4961	0.0249	0.0332	0.2479	0.3963	1.62E-03	1.51E-01
1.000	0.2672	0.0102	122	0.7149	0.4244	1.4610	0.0351	0.0468	0.2427	0.3800	2.63E-03	2.45E-01
2.000	0.2996	0.0324	313	0.6825	0.3920	1.3495	0.0675	0.0900	0.2307	0.3434	9.30E-04	8.64E-02
4.000	0.3477	0.0481	148	0.6344	0.3439	1.1839	0.1156	0.1541	0.2060	0.2738	1.57E-03	1.46E-01
8.000	0.3923	0.0446	240	0.5898	0.2993	1.0304	0.1602	0.2136	0.1829	0.2157	7.62E-04	7.09E-02
16.000	0.4276	0.0353	122	0.5545	0.2640	0.9088	0.1955	0.2607	0.1666	0.1790	1.24E-03	1.15E-01
4.000	0.4264	-0.0012	122	0.5557	0.2652	0.9130	0.1943	0.2591	0.1602	0.1656	1.15E-03	1.07E-01
2.000	0.4209	-0.0055	60	0.5612	0.2707	0.9319	0.1888	0.2517	0.1629	0.1711	2.42E-03	2.25E-01
1.000	0.4068	-0.0141	207	0.5753	0.2848	0.9805	0.1747	0.2329	0.1696	0.1855	7.60E-04	7.06E-02

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #:

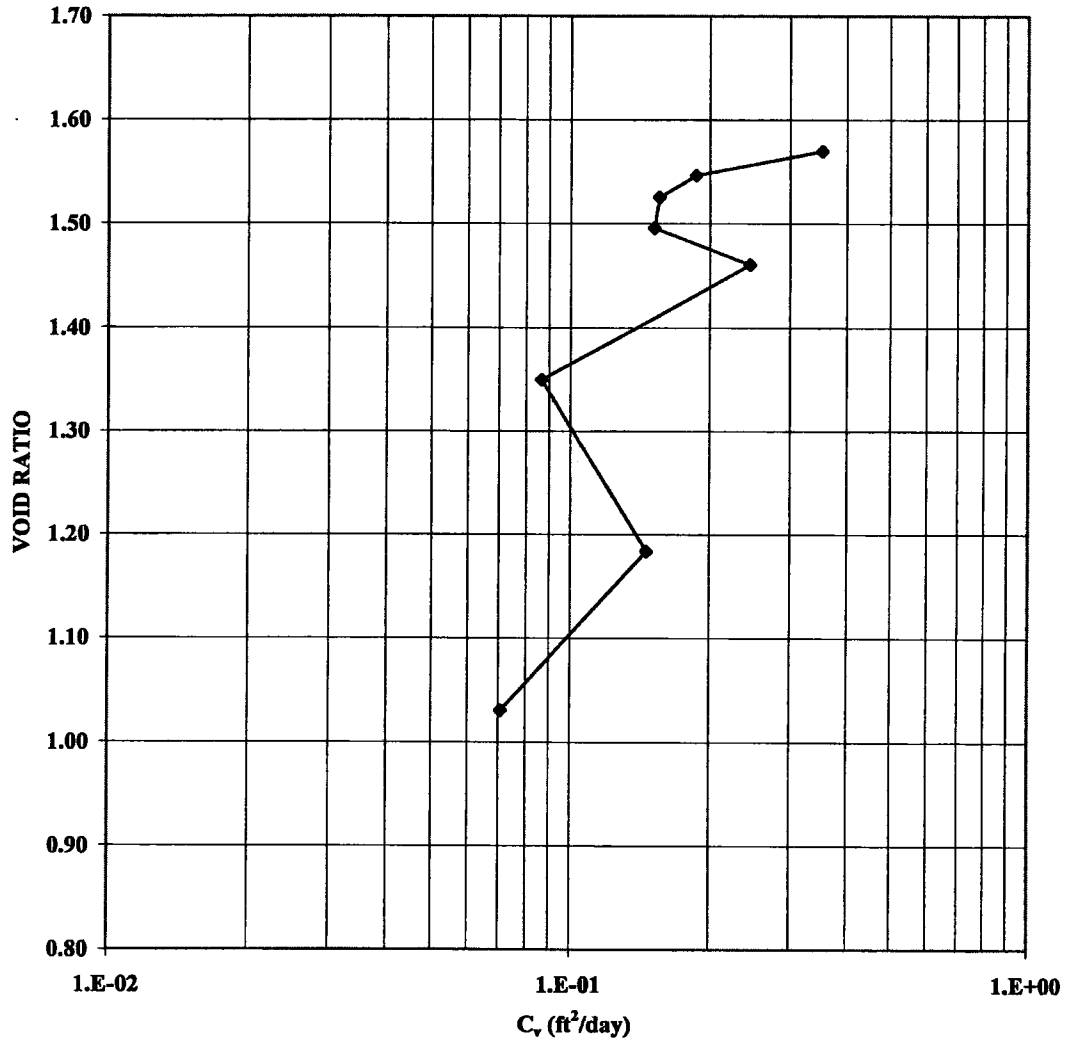
RD-3 ST-3
18'-20'

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

DATE	10/7/2005
TECH	RMW/ND
REVIEW	RMW

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #:

RD-3 ST-3
18'-20'

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

DATE	10/7/2005
TECH	RMW/ND
REVIEW	RMW

ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300	RD-4 ST-2 6'-8'	DATE 10/7/2005
		TECH RMW/ND
		REVIEW RMW

SAMPLE DATA, GENERAL

height (in)	0.750
diameter (in)	2.500
area (in ²)	4.909
volume (in ³)	3.682
specimen weight, wet (g)	132.15
specimen weight, dry (g)	109.85
water weight (g)	22.30

SAMPLE DATA, INITIAL

total height (in)	0.750
height of solids (in)	0.495
height of voids (in)	0.255
height of water (in)	0.277
void ratio	0.517
% saturation	108.46%
dry density (pcf)	113.67
moist density (pcf)	136.74

SAMPLE DATA, FINAL

total height (in)	0.712
height of solids (in)	0.495
height of voids (in)	0.218
height of water (in)	0.220
void ratio	0.440
% saturation	100.99%
dry density (pcf)	119.69
moist density (pcf)	138.97

DESCRIPTION

LL:
PL:
PI:
Gs: 2.76

MOISTURE CONTENT, INITIAL

tare #	CH21
wt soil&tare,moist	82.45
wt soil&tare,dry	73.88
wt tare	31.33
wt moisture	8.57
wt dry soil	42.55
% moisture	20.14%

MOISTURE CONTENT, FINAL

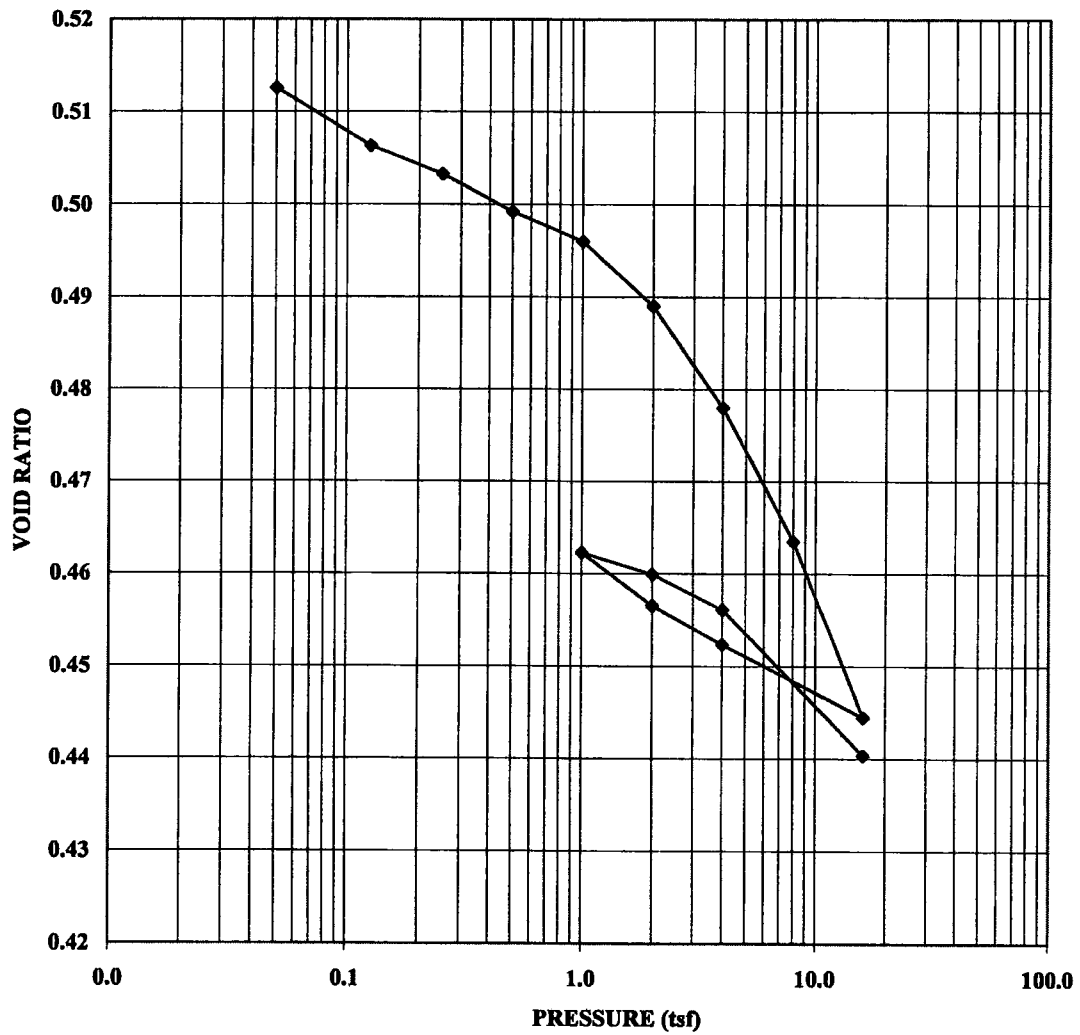
tare #	CH025
wt soil&tare,moist	177.32
wt soil&tare,dry	159.62
wt tare	49.77
wt moisture	17.70
wt dry soil	109.85
% moisture	16.11%

PRESSURE (tsf)	R ₉₀ DIAL READING	DIAL CHANGE (in)	FITTING TIME (sec) t ₉₀	SPECIMEN HEIGHT (in)	HEIGHT OF VOIDS H _v	VOID RATIO e	CHANGE IN HEIGHT (cumulative)	STRAIN %	DRAINAGE PATH (DOUBLE DRAINAGE)		COEFFICIENT OF CONSOLIDATION	
									H (in)	H ² (cm ²)	C _v (cm ² /sec)	(ft ² /day)
0.000	0.2427	0.0000	0	0.7500	0.2555	0.5166	0.0000	0.0000	0.0000	0.0000	0.00E+00	0.00E+00
0.050	0.2447	0.0020	107	0.7480	0.2535	0.5126	0.0020	0.0027	0.2605	0.4378	3.48E-03	3.24E-01
0.125	0.2478	0.0031	240	0.7449	0.2504	0.5063	0.0051	0.0068	0.2588	0.4319	1.53E-03	1.42E-01
0.250	0.2493	0.0015	60	0.7434	0.2489	0.5033	0.0066	0.0088	0.2504	0.4045	5.72E-03	5.32E-01
0.500	0.2513	0.0020	240	0.7414	0.2469	0.4992	0.0086	0.0115	0.2495	0.4015	1.42E-03	1.32E-01
1.000	0.2529	0.0016	60	0.7398	0.2453	0.4960	0.0102	0.0136	0.2487	0.3989	5.64E-03	5.24E-01
2.000	0.2564	0.0035	99	0.7364	0.2418	0.4890	0.0137	0.0182	0.2470	0.3936	3.37E-03	3.13E-01
4.000	0.2618	0.0054	122	0.7309	0.2364	0.4780	0.0191	0.0255	0.2443	0.3850	2.67E-03	2.48E-01
8.000	0.2690	0.0072	79	0.7237	0.2292	0.4635	0.0263	0.0350	0.2408	0.3741	4.04E-03	3.75E-01
16.000	0.2784	0.0094	99	0.7143	0.2198	0.4445	0.0357	0.0475	0.2361	0.3596	3.08E-03	2.86E-01
4.000	0.2745	-0.0039	60	0.7183	0.2237	0.4524	0.0318	0.0423	0.2377	0.3645	5.15E-03	4.79E-01
2.000	0.2724	-0.0021	122	0.7203	0.2258	0.4566	0.0297	0.0396	0.2388	0.3678	2.55E-03	2.37E-01
1.000	0.2696	-0.0028	148	0.7231	0.2286	0.4623	0.0269	0.0358	0.2401	0.3718	2.13E-03	1.98E-01
2.000	0.2707	0.0011	44	0.7220	0.2275	0.4600	0.0280	0.0373	0.2396	0.3704	7.07E-03	6.58E-01
4.000	0.2726	0.0019	99	0.7201	0.2256	0.4561	0.0299	0.0399	0.2388	0.3678	3.15E-03	2.93E-01
16.000	0.2804	0.0078	148	0.7123	0.2178	0.4404	0.0377	0.0503	0.2350	0.3562	2.04E-03	1.89E-01

GOLDER ASSOCIATES INC.

CHERRY HILL, NEW JERSEY

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #:

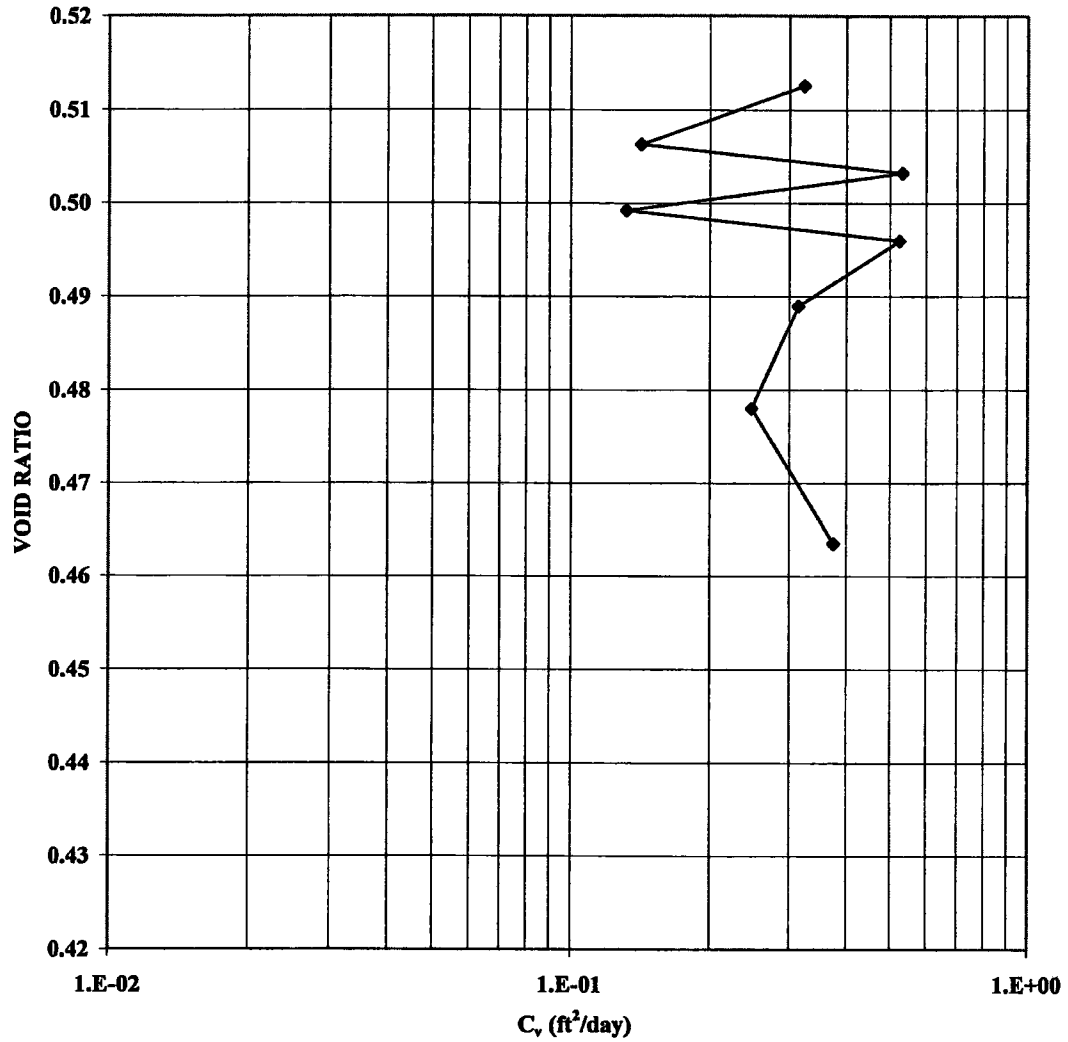
RD-4 ST-2
6'-8'

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

DATE	10/7/2005
TECH	RMW/ND
REVIEW	RMW

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #:

RD-4 ST-2
6'-8'

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

DATE	10/7/2005
TECH	RMW/ND
REVIEW	RMW

ONE-DIMENSIONAL CONSOLIDATION

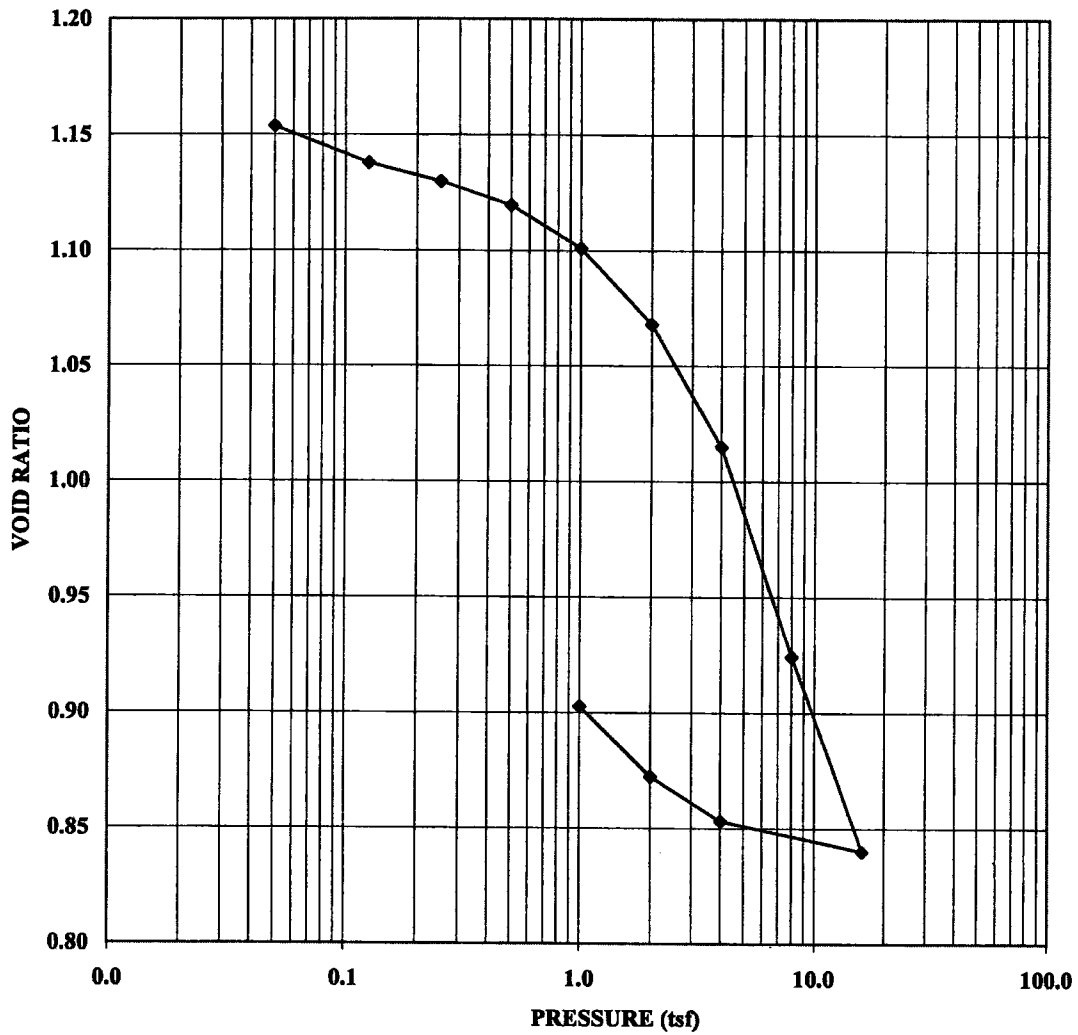
ASTM D 2435

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				RD-4 ST-3 12'-14'				DATE 10/7/2005 TECH RMW/ND REVIEW RMW			
SAMPLE DATA, GENERAL				SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL			
height (in)	0.750			total height (in)	0.750			total height (in)	0.657		
diameter (in)	2.500			height of solids (in)	0.345			height of solids (in)	0.345		
area (in ²)	4.909			height of voids (in)	0.405			height of voids (in)	0.311		
volume (in ³)	3.682			height of water (in)	0.404			height of water (in)	0.346		
specimen weight, wet (g)	111.92			void ratio	1.174			void ratio	0.903		
specimen weight, dry (g)	79.42			% saturation	99.71%			% saturation	111.10%		
water weight (g)	32.50			dry density (pcf)	82.18			dry density (pcf)	93.88		
				moist density (pcf)	115.81			moist density (pcf)	126.81		
DESCRIPTION				MOISTURE CONTENT, INITIAL				MOISTURE CONTENT, FINAL			
<div style="border: 1px solid black; height: 40px; width: 100%;"></div> LL: PL: PI: Gs: 2.86				tare #	N9			tare #	1		
				wt soil&tare,moist	65.25			wt soil&tare,moist	445.94		
				wt soil&tare,dry	56.36			wt soil&tare,dry	418.09		
				wt tare	31.28			wt tare	338.67		
				wt moisture	8.89			wt moisture	27.85		
				wt dry soil	25.08			wt dry soil	79.42		
				% moisture	35.45%			% moisture	35.07%		

PRESSURE (tsf)	R ₉₀ DIAL READING	DIAL CHANGE (in)	FITTING TIME (sec) t ₉₀	SPECIMEN HEIGHT (in)	HEIGHT OF VOIDS H _v	VOID RATIO e	CHANGE IN HEIGHT (cumulative)	STRAIN %	DRAINAGE PATH (DOUBLE DRAINAGE)		COEFFICIENT OF CONSOLIDATION	
									H (in)	H' (cm)	C _v (cm ² /sec)	(ft ² /day)
0.000	0.2220	0.0000	0	0.7500	0.4050	1.1737	0.0000	0.0000	0.0000	0.0000	0.00E+00	0.00E+00
0.050	0.2289	0.0069	187	0.7431	0.3981	1.1537	0.0069	0.0092	0.2621	0.4432	2.01E-03	1.87E-01
0.125	0.2343	0.0054	240	0.7377	0.3926	1.1379	0.0123	0.0165	0.2571	0.4263	1.51E-03	1.40E-01
0.250	0.2372	0.0028	79	0.7349	0.3898	1.1298	0.0152	0.0202	0.2565	0.4245	4.58E-03	4.26E-01
0.500	0.2407	0.0035	162	0.7314	0.3863	1.1197	0.0187	0.0249	0.2553	0.4205	2.20E-03	2.05E-01
1.000	0.2471	0.0064	122	0.7250	0.3799	1.1011	0.0251	0.0334	0.2525	0.4113	2.85E-03	2.65E-01
2.000	0.2585	0.0115	240	0.7135	0.3685	1.0679	0.0365	0.0487	0.2474	0.3949	1.40E-03	1.30E-01
4.000	0.2768	0.0183	148	0.6952	0.3502	1.0149	0.0548	0.0731	0.2396	0.3704	2.12E-03	1.97E-01
8.000	0.3081	0.0313	162	0.6639	0.3189	0.9242	0.0861	0.1148	0.2247	0.3256	1.70E-03	1.58E-01
16.000	0.3371	0.0290	60	0.6349	0.2899	0.8401	0.1151	0.1535	0.2139	0.2950	4.17E-03	3.88E-01
4.000	0.3326	-0.0045	110	0.6394	0.2944	0.8532	0.1106	0.1475	0.2078	0.2785	2.14E-03	1.99E-01
2.000	0.3260	-0.0066	148	0.6460	0.3010	0.8723	0.1040	0.1387	0.2111	0.2875	1.65E-03	1.53E-01
1.000	0.3155	-0.0105	240	0.6565	0.3115	0.9027	0.0935	0.1247	0.2156	0.2999	1.06E-03	9.85E-02

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #:

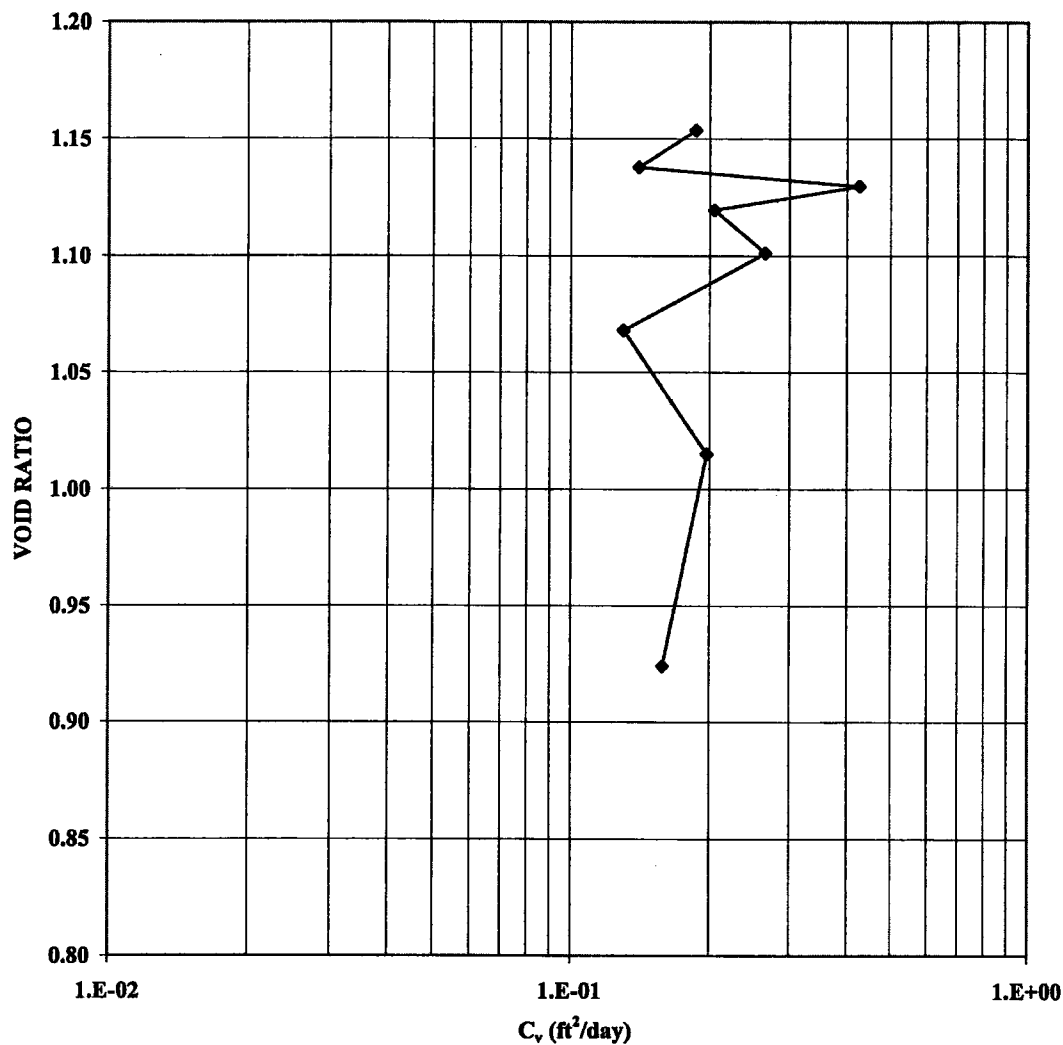
RD-4 ST-3
12'-14'

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

DATE	10/7/2005
TECH	RMW/ND
REVIEW	RMW

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #:

RD-4 ST-3
12'-14'

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

DATE	10/7/2005
TECH	RMW/ND
REVIEW	RMW

ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				RD-5 ST-2 8'-10'				DATE 10/7/2005 TECH RMW/ND REVIEW RMW			
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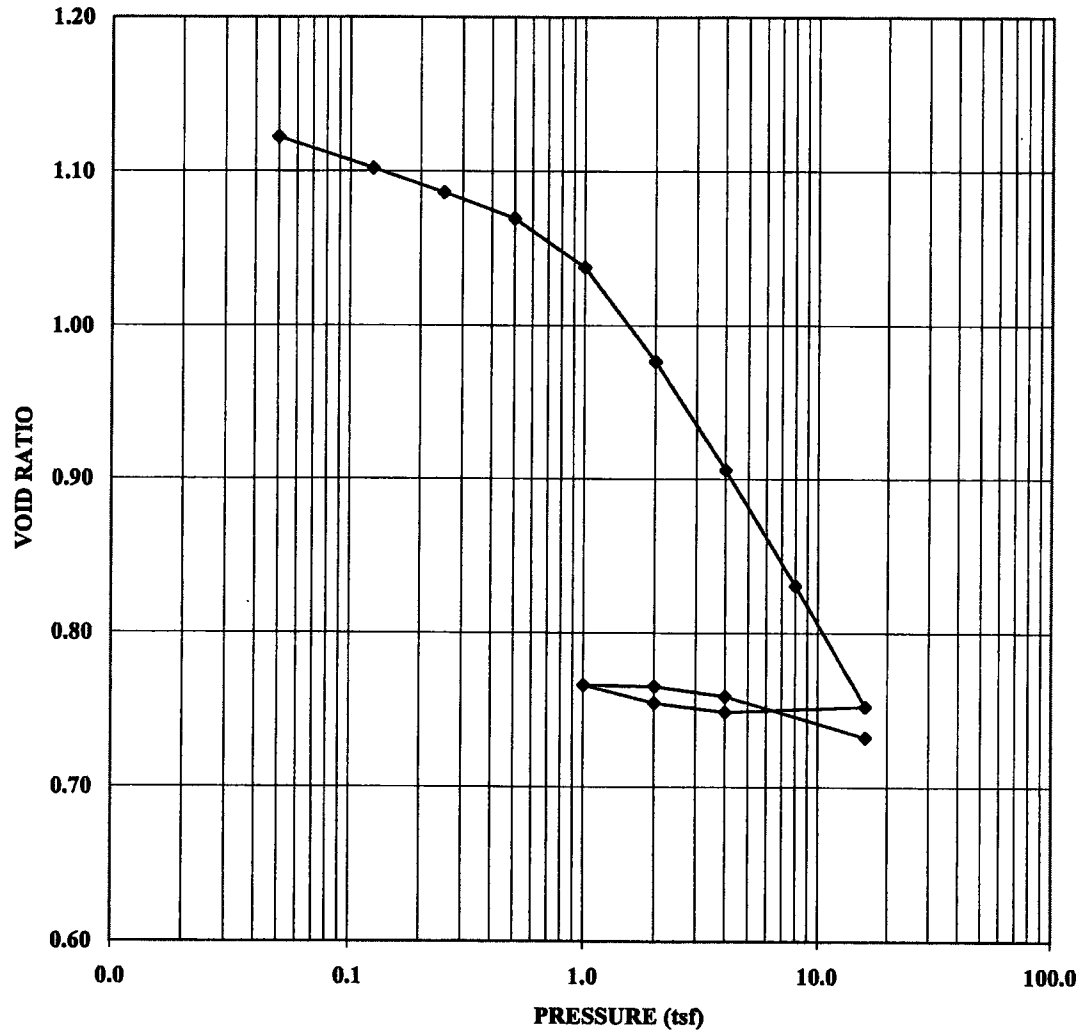
SAMPLE DATA, GENERAL				SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL			
height (in)	0.750	total height (in)	0.750	total height (in)	0.608						
diameter (in)	2.500	height of solids (in)	0.351	height of solids (in)	0.351						
area (in ²)	4.909	height of voids (in)	0.399	height of voids (in)	0.257						
volume (in ³)	3.682	height of water (in)	0.417	height of water (in)	0.267						
specimen weight, wet (g)	107.60	void ratio	1.136	void ratio	0.732						
specimen weight, dry (g)	74.03	% saturation	104.56%	% saturation	103.80%						
water weight (g)	33.57	dry density (pcf)	76.60	dry density (pcf)	94.46						
		moist density (pcf)	111.34	moist density (pcf)	121.87						

DESCRIPTION		MOISTURE CONTENT, INITIAL		MOISTURE CONTENT, FINAL	
		tare #	N2	tare #	R21
		wt soil&tare,moist	77.86	wt soil&tare,moist	147.45
		wt soil&tare,dry	64.43	wt soil&tare,dry	125.97
		wt tare	31.79	wt tare	51.94
		wt moisture	13.43	wt moisture	21.48
		wt dry soil	32.64	wt dry soil	74.03
LL: _____		% moisture	41.15%	% moisture	29.02%
PL: _____					
PI: _____					
Gs: 2.62					

PRESSURE (tsf)	R ₅₀ DIAL READING	DIAL CHANGE (in)	FITTING TIME (sec) t ₅₀	SPECIMEN HEIGHT (in)	HEIGHT OF VOIDS H _v	VOID RATIO e	CHANGE IN HEIGHT (cumulative)	STRAIN %	DRAINAGE PATH (DOUBLE DRAINAGE)		COEFFICIENT OF CONSOLIDATION	
									H (in)	H ² (cm ²)	C _v (cm ² /sec)	(ft ² /day)
0.000	0.2439	0.0000	0	0.7500	0.3989	1.1363	0.0000	0.0000	0.0000	0.0000	0.00E+00	0.00E+00
0.050	0.2489	0.0050	64	0.7450	0.3939	1.1221	0.0050	0.0066	0.2517	0.4086	5.40E-03	5.02E-01
0.125	0.2561	0.0072	148	0.7378	0.3868	1.1016	0.0122	0.0162	0.2478	0.3962	2.27E-03	2.11E-01
0.250	0.2615	0.0054	334	0.7324	0.3814	1.0863	0.0176	0.0234	0.2448	0.3866	9.83E-04	9.14E-02
0.500	0.2674	0.0060	99	0.7265	0.3754	1.0693	0.0235	0.0314	0.2422	0.3783	3.24E-03	3.01E-01
1.000	0.2785	0.0111	135	0.7154	0.3643	1.0377	0.0346	0.0461	0.2373	0.3633	2.28E-03	2.12E-01
2.000	0.2999	0.0214	110	0.6940	0.3429	0.9768	0.0560	0.0747	0.2272	0.3329	2.56E-03	2.38E-01
4.000	0.3247	0.0248	88	0.6692	0.3181	0.9061	0.0808	0.1077	0.2149	0.2979	2.86E-03	2.66E-01
8.000	0.3512	0.0265	110	0.6427	0.2916	0.8307	0.1073	0.1431	0.2014	0.2616	2.01E-03	1.87E-01
16.000	0.3786	0.0274	88	0.6153	0.2642	0.7526	0.1347	0.1796	0.1879	0.2278	2.19E-03	2.04E-01
4.000	0.3799	0.0013	99	0.6140	0.2629	0.7488	0.1360	0.1814	0.1849	0.2206	1.89E-03	1.76E-01
2.000	0.3780	-0.0020	176	0.6160	0.2649	0.7545	0.1341	0.1787	0.1859	0.2228	1.07E-03	9.96E-02
1.000	0.3738	-0.0041	191	0.6201	0.2690	0.7663	0.1299	0.1732	0.1877	0.2273	1.01E-03	9.36E-02
2.000	0.3741	0.0002	257	0.6199	0.2688	0.7656	0.1302	0.1735	0.1881	0.2281	7.52E-04	6.99E-02
4.000	0.3764	0.0024	60	0.6175	0.2664	0.7588	0.1325	0.1767	0.1870	0.2255	3.19E-03	2.96E-01
16.000	0.3857	0.0093	122	0.6082	0.2571	0.7324	0.1418	0.1891	0.1827	0.2153	1.49E-03	1.39E-01

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #:

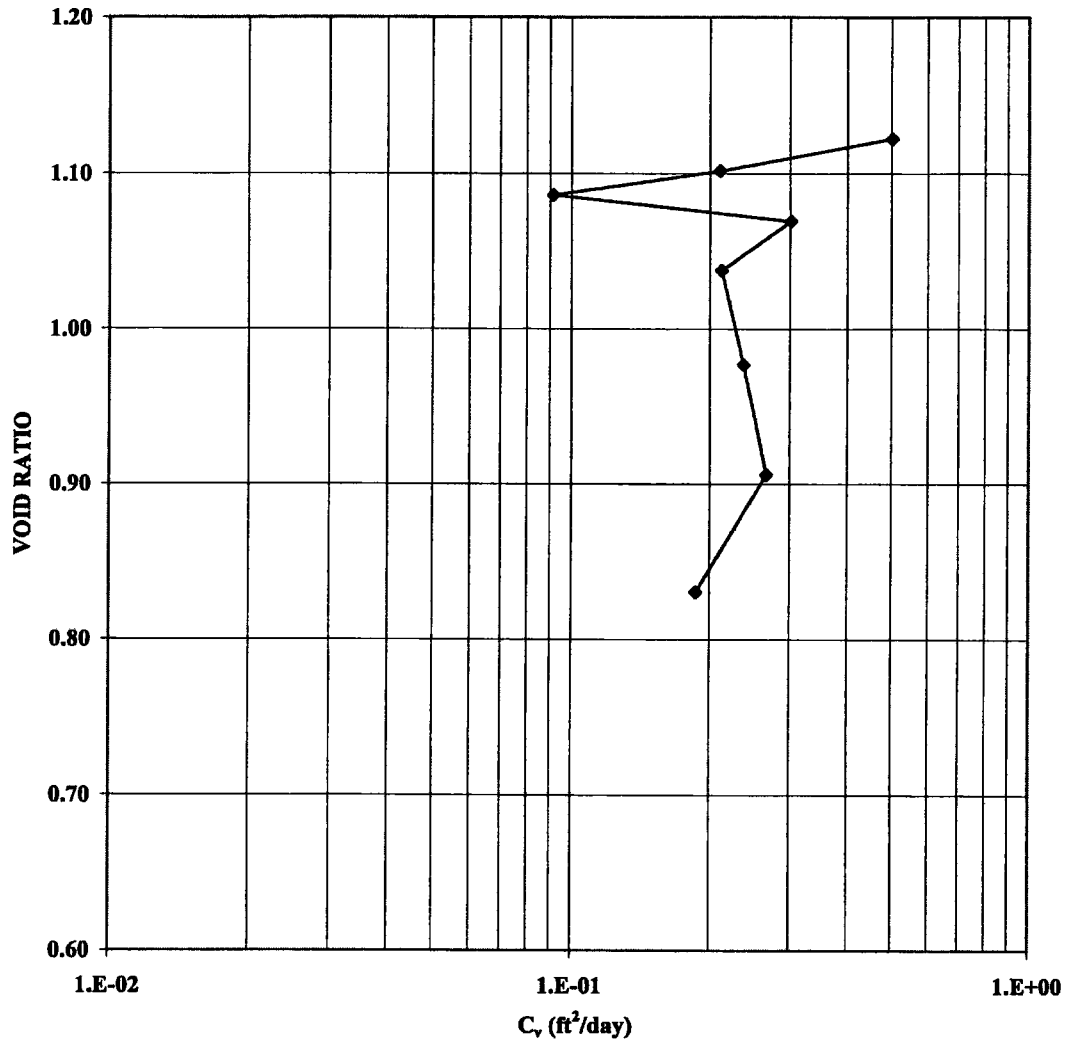
RD-5 ST-2
8'-10'

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

DATE	10/7/2005
TECH	RMW/ND
REVIEW	RMW

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #:

RD-5 ST-2
8'-10'

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

DATE	10/7/2005
TECH	RMW/ND
REVIEW	RMW

ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				RD-5 ST-4 16'-18'				DATE 10/7/2005 TECH RMW/ND REVIEW RMW			
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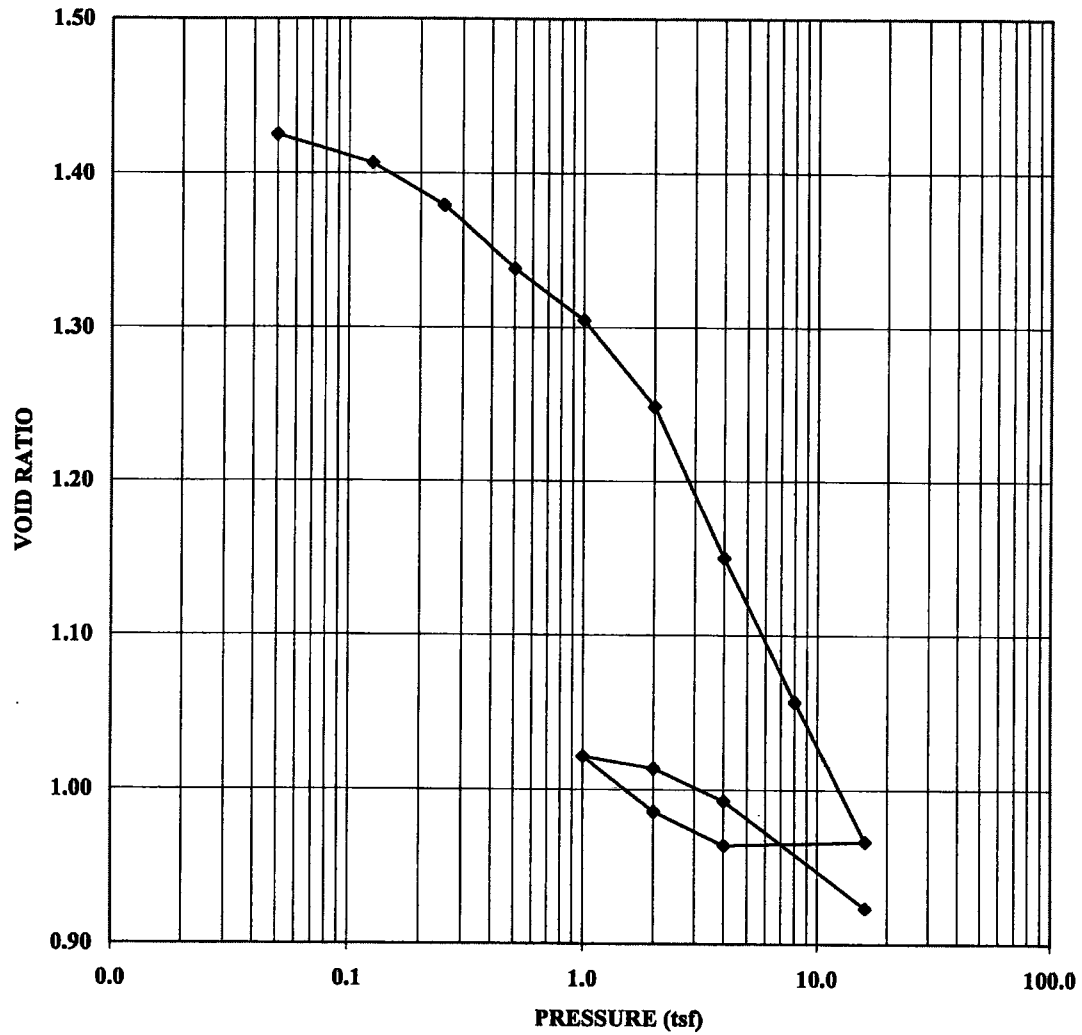
SAMPLE DATA, GENERAL				SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL			
height (in)	0.750	total height (in)	0.750	total height (in)	0.592						
diameter (in)	2.500	height of solids (in)	0.308	height of solids (in)	0.308						
area (in ²)	4.909	height of voids (in)	0.442	height of voids (in)	0.284						
volume (in ³)	3.682	height of water (in)	0.433	height of water (in)	0.282						
specimen weight, wet (g)	105.63	void ratio	1.439	void ratio	0.923						
specimen weight, dry (g)	70.79	% saturation	97.84%	% saturation	99.37%						
water weight (g)	34.84	dry density (pcf)	73.25	dry density (pcf)	92.88						
		moist density (pcf)	109.30	moist density (pcf)	122.67						

DESCRIPTION		MOISTURE CONTENT, INITIAL		MOISTURE CONTENT, FINAL	
		tare #	N2	tare #	SMCK7
		wt soil&tare,moist	99.09	wt soil&tare,moist	241.84
		wt soil&tare,dry	78.56	wt soil&tare,dry	219.13
		wt tare	31.77	wt tare	148.34
		wt moisture	20.53	wt moisture	22.71
		wt dry soil	46.79	wt dry soil	70.79
		% moisture	43.88%	% moisture	32.08%

PRESSURE (tsf)	R ₉₀ DIAL READING	DIAL CHANGE (in)	FITTING TIME (sec) t ₉₀	SPECIMEN HEIGHT (in)	HEIGHT OF VOIDS H _v	VOID RATIO e	CHANGE IN HEIGHT (cumulative)	STRAIN %	DRAINAGE PATH (DOUBLE DRAINAGE)		COEFFICIENT OF CONSOLIDATION	
									H (in)	H ² (cm ²)	C _v (cm ² /sec)	(ft ² /day)
0.000	0.0927	0.0000	0	0.7500	0.4425	1.4387	0.0000	0.0000	0.0000	0.0000	0.00E+00	0.00E+00
0.050	0.0969	0.0042	245	0.7458	0.4383	1.4250	0.0042	0.0056	0.3275	0.6919	2.40E-03	2.23E-01
0.125	0.1026	0.0057	207	0.7401	0.4326	1.4065	0.0099	0.0132	0.3244	0.6789	2.78E-03	2.59E-01
0.250	0.1110	0.0084	893	0.7317	0.4242	1.3792	0.0183	0.0244	0.3207	0.6636	6.30E-04	5.86E-02
0.500	0.1237	0.0127	593	0.7191	0.4115	1.3381	0.0310	0.0413	0.3154	0.6418	9.18E-04	8.54E-02
1.000	0.1339	0.0103	375	0.7088	0.4012	1.3046	0.0412	0.0550	0.3097	0.6188	1.40E-03	1.30E-01
2.000	0.1512	0.0173	207	0.6915	0.3840	1.2485	0.0585	0.0780	0.3029	0.5917	2.42E-03	2.25E-01
4.000	0.1814	0.0302	240	0.6614	0.3538	1.1505	0.0887	0.1182	0.2889	0.5385	1.90E-03	1.77E-01
8.000	0.2101	0.0288	257	0.6326	0.3251	1.0570	0.1174	0.1565	0.2740	0.4845	1.60E-03	1.48E-01
16.000	0.2379	0.0278	99	0.6048	0.2973	0.9666	0.1452	0.1936	0.2609	0.4390	3.76E-03	3.50E-01
4.000	0.2387	0.0008	88	0.6040	0.2965	0.9640	0.1460	0.1947	0.2545	0.4179	4.02E-03	3.74E-01
2.000	0.2320	-0.0067	176	0.6107	0.3032	0.9858	0.1393	0.1857	0.2577	0.4283	2.06E-03	1.91E-01
1.000	0.2210	-0.0110	313	0.6217	0.3142	1.0215	0.1283	0.1711	0.2624	0.4442	1.20E-03	1.12E-01
2.000	0.2233	0.0023	122	0.6194	0.3119	1.0140	0.1306	0.1741	0.2643	0.4505	3.12E-03	2.90E-01
4.000	0.2298	0.0065	99	0.6129	0.3054	0.9929	0.1371	0.1828	0.2612	0.4400	3.77E-03	3.50E-01
16.000	0.2512	0.0214	99	0.5915	0.2840	0.9233	0.1585	0.2113	0.2539	0.4157	3.56E-03	3.31E-01

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #:

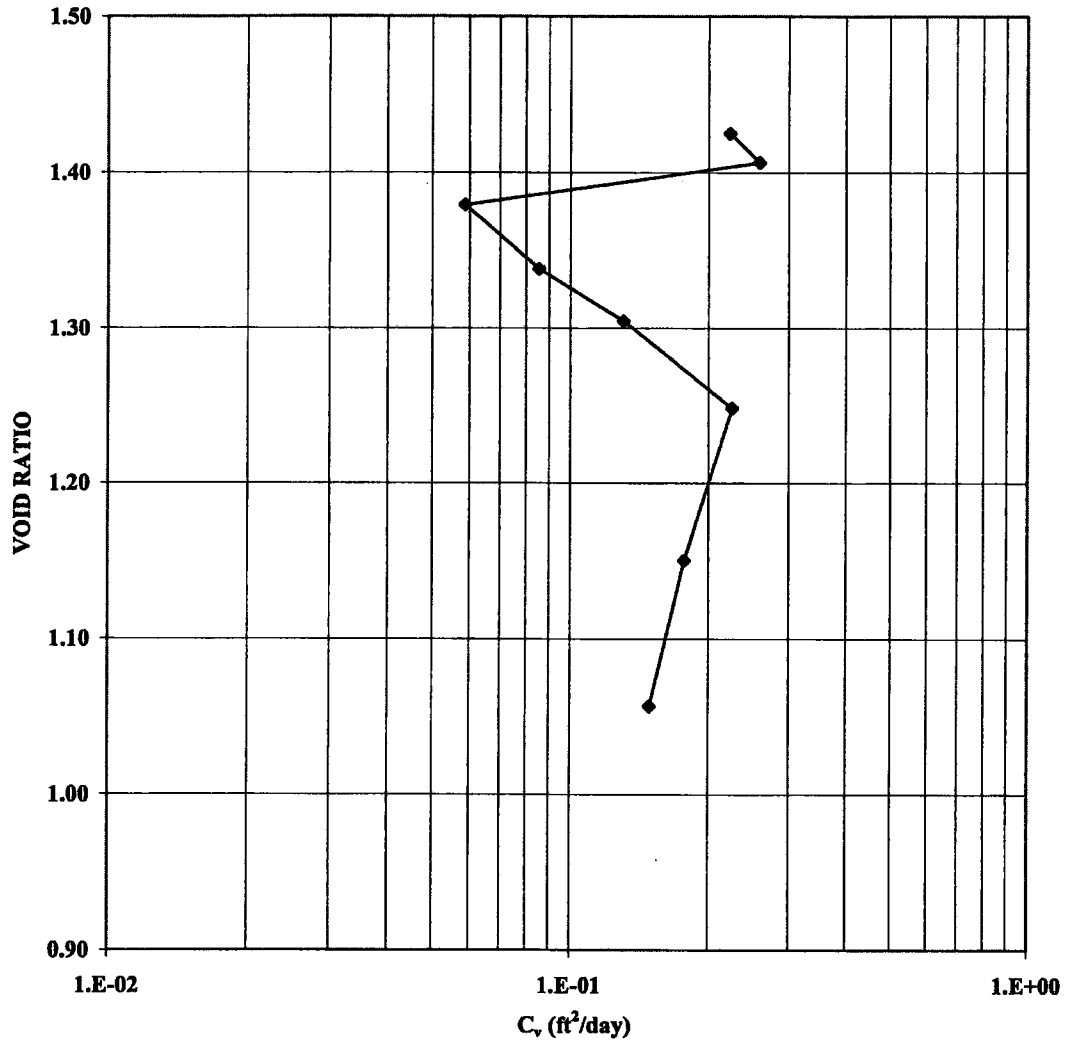
RD-5 ST-4
16'-18'

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

DATE	10/7/2005
TECH	RMW/ND
REVIEW	RMW

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #:

RD-5 ST-4
16'-18'

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

DATE	10/7/2005
TECH	RMW/ND
REVIEW	RMW

ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

CARLSTADT PRP/FACILITY COORDINATOR	RD-5 ST-5	DATE	10/7/2005
943-6222.0300	28'-30'	TECH	RMW/ND
		REVIEW	RMW

SAMPLE DATA, GENERAL

height (in)	0.750
diameter (in)	2.500
area (in ²)	4.909
volume (in ³)	3.682
specimen weight, wet (g)	105.86
specimen weight, dry (g)	71.04
water weight (g)	34.82

SAMPLE DATA, INITIAL

total height (in)	0.750
height of solids (in)	0.308
height of voids (in)	0.442
height of water (in)	0.433
void ratio	1.439
% saturation	97.78%
dry density (pcf)	73.51
moist density (pcf)	109.54

SAMPLE DATA, FINAL

total height (in)	0.629
height of solids (in)	0.308
height of voids (in)	0.322
height of water (in)	0.337
void ratio	1.045
% saturation	104.69%
dry density (pcf)	87.64
moist density (pcf)	121.06

DESCRIPTION

LL:	
PL:	
PI:	
Gs:	2.87

MOISTURE CONTENT, INITIAL

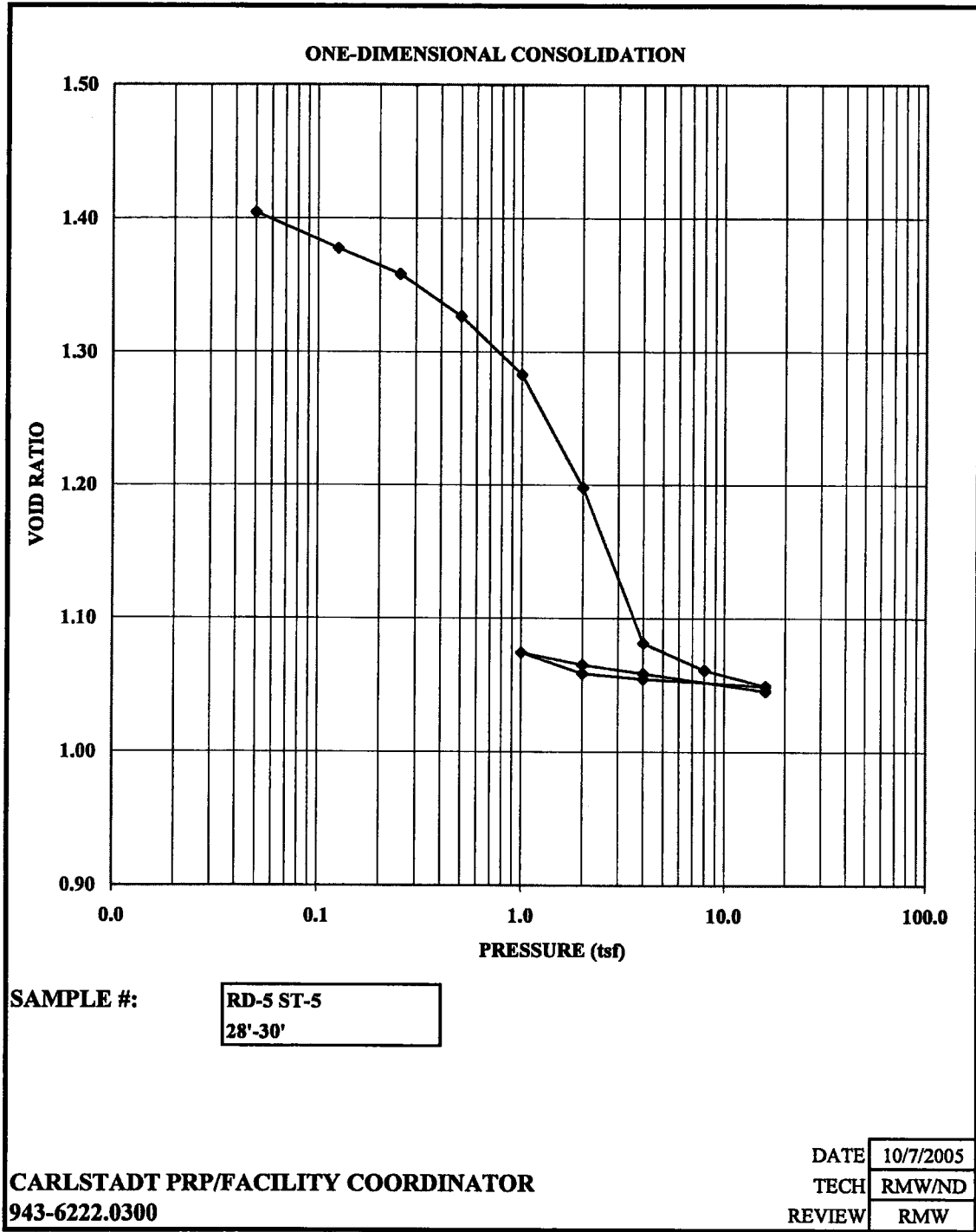
tare #	RD4
wt soil&tare,moist	191.05
wt soil&tare,dry	142.43
wt tare	37.67
wt moisture	48.62
wt dry soil	104.76
% moisture	46.41%

MOISTURE CONTENT, FINAL

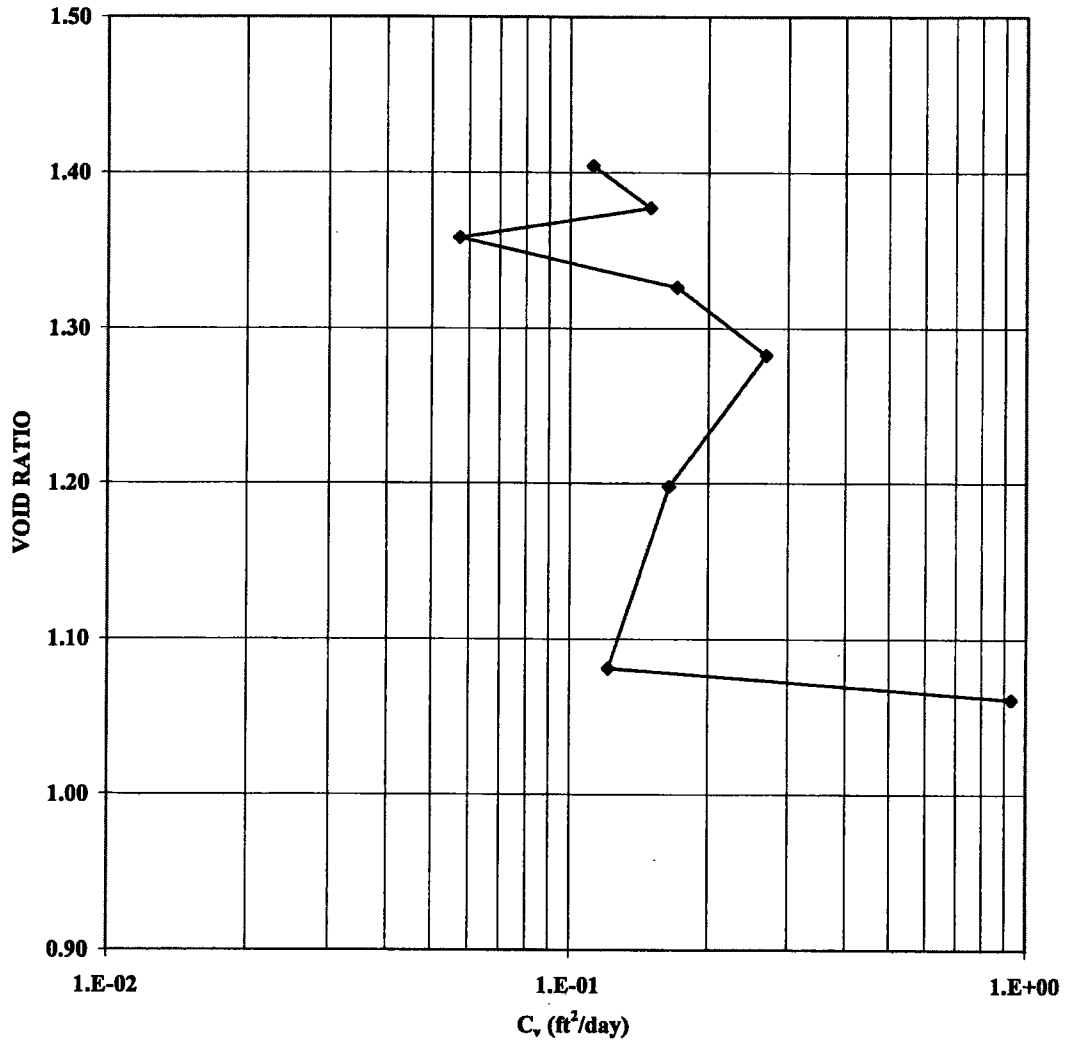
tare #	GH13
wt soil&tare,moist	256.19
wt soil&tare,dry	229.10
wt tare	158.06
wt moisture	27.09
wt dry soil	71.04
% moisture	38.13%

PRESSURE (tsf)	R ₉₀ DIAL READING	DIAL CHANGE (in)	FITTING TIME (sec) t ₉₀	SPECIMEN HEIGHT (in)	HEIGHT OF VOIDS H _v	VOID RATIO e	CHANGE IN HEIGHT (cumulative)	STRAIN %	DRAINAGE PATH (DOUBLE DRAINAGE)		COEFFICIENT OF CONSOLIDATION	
									H (in)	H ² (cm ²)	C _v (cm ² /sec)	(R ² /day)
0.000	0.0694	0.0000	0	0.7500	0.4424	1.4386	0.0000	0.0000	0.0000	0.0000	0.00E+00	0.00E+00
0.050	0.0799	0.0106	515	0.7395	0.4319	1.4043	0.0106	0.0141	0.3374	0.7344	1.21E-03	1.12E-01
0.125	0.0882	0.0083	375	0.7311	0.4236	1.3773	0.0189	0.0251	0.3319	0.7108	1.61E-03	1.49E-01
0.250	0.0941	0.0059	960	0.7253	0.4177	1.3581	0.0248	0.0330	0.3285	0.6960	6.15E-04	5.72E-02
0.500	0.1039	0.0098	313	0.7155	0.4079	1.3263	0.0346	0.0461	0.3247	0.6802	1.84E-03	1.71E-01
1.000	0.1173	0.0134	191	0.7021	0.3945	1.2827	0.0480	0.0639	0.3174	0.6497	2.88E-03	2.68E-01
2.000	0.1433	0.0260	294	0.6761	0.3685	1.1982	0.0740	0.0986	0.3084	0.6134	1.77E-03	1.64E-01
4.000	0.1792	0.0359	355	0.6402	0.3326	1.0814	0.1099	0.1465	0.2912	0.5471	1.31E-03	1.22E-01
8.000	0.1855	0.0063	44	0.6339	0.3263	1.0611	0.1161	0.1548	0.2830	0.5168	1.00E-02	9.30E-01
16.000	0.1891	0.0036	52	0.6303	0.3227	1.0493	0.1198	0.1597	0.2807	0.5083	8.35E-03	7.77E-01
4.000	0.1874	-0.0017	44	0.6319	0.3244	1.0547	0.1181	0.1574	0.2812	0.5100	9.87E-03	9.18E-01
2.000	0.1862	-0.0012	60	0.6331	0.3256	1.0586	0.1169	0.1559	0.2818	0.5123	7.24E-03	6.73E-01
1.000	0.1815	-0.0048	122	0.6379	0.3303	1.0741	0.1121	0.1495	0.2832	0.5175	3.59E-03	3.33E-01
2.000	0.1842	0.0028	99	0.6351	0.3276	1.0652	0.1149	0.1531	0.2839	0.5200	4.45E-03	4.14E-01
4.000	0.1862	0.0020	99	0.6332	0.3256	1.0588	0.1168	0.1558	0.2821	0.5132	4.39E-03	4.08E-01
16.000	0.1903	0.0041	79	0.6291	0.3215	1.0454	0.1209	0.1612	0.2801	0.5060	5.46E-03	5.08E-01

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY



ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #:

RD-5 ST-5
28'-30'

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

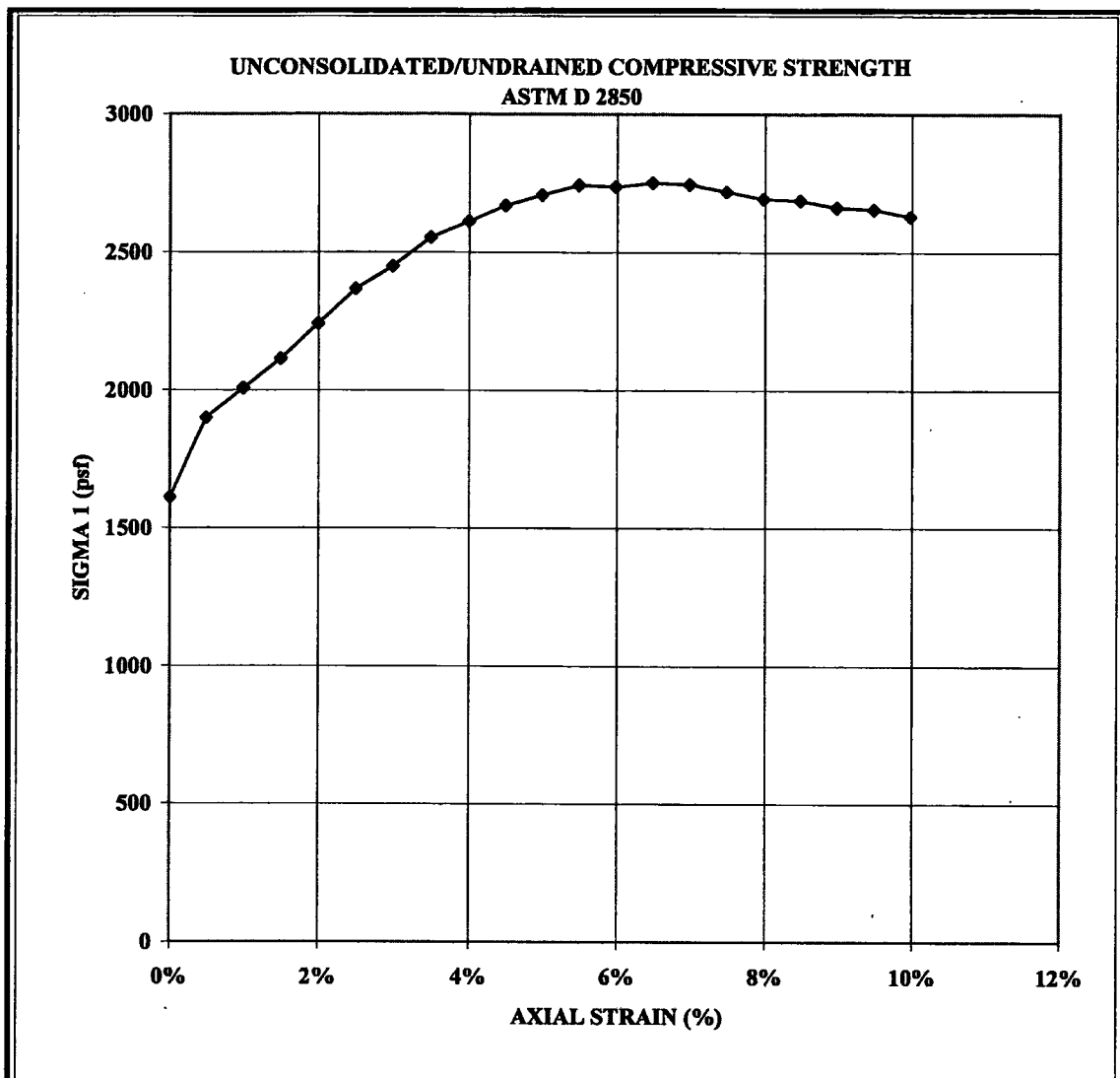
DATE	10/7/2005
TECH	RMW/ND
REVIEW	RMW

UNCONSOLIDATED/UNDRAINED COMPRESSIVE STRENGTH OF SOILS

ASTM D 2850

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				SAMPLE #: RD-1 ST-2 14'-16'					
SAMPLE DATA						SKETCH			
height (in)	6.020	confining pressure (psi)	11.2						
diameter (in)	2.877	machine speed (in/min)	0.06						
area (in ²)	6.501	strain rate (%/min)	1.00						
height/diameter ratio	2.09								
volume (in ³)	39.14	MOISTURE CONTENT							
weight (g)	1129.28	tare #	MM74						
specific gravity	2.70	wt soil&tare,moist (g)	1282.55						
moist density (pcf)	109.88	wt soil&tare,dry (g)	931.16						
dry density (pcf)	75.83	wt tare (g)	148.71						
volume,solids (in ³)	17.61	wt moisture (g)	351.39						
volume,voids (in ³)	21.52	wt dry soil (g)	782.45						
% saturation	99.23%	% moisture	44.91%						
TIME (min)	DEFLECTION (in)	AXIAL LOAD (lbs)	STRAIN (%)	ARBA,CORR (in ³)	DEVIATOR STRESS (psf)	SIGMA 1 (psf)	P (psf)	Q (psf)	
0.0	0.00	0.0	0.00%	6.501	0.00	1612.8	1612.8	0	
0.5	0.03	13.0	0.50%	6.533	286.53	1899.33	1756.06	143.26	
1.0	0.06	18.0	1.00%	6.566	394.74	2007.54	1810.17	197.37	
1.5	0.09	23.0	1.50%	6.600	501.86	2114.66	1863.73	250.93	
2.0	0.12	29.0	1.99%	6.633	629.57	2242.37	1927.59	314.79	
2.5	0.15	35.0	2.49%	6.667	755.97	2368.77	1990.78	377.98	
3.0	0.18	39.0	2.99%	6.701	838.06	2450.86	2031.83	419.03	
3.5	0.21	44.0	3.49%	6.736	940.64	2553.44	2083.12	470.32	
4.0	0.24	47.0	3.99%	6.771	999.59	2612.39	2112.60	499.80	
4.5	0.27	50.0	4.49%	6.806	1057.87	2670.67	2141.74	528.94	
5.0	0.30	52.0	4.98%	6.842	1094.45	2707.25	2160.02	547.22	
5.5	0.33	54.0	5.48%	6.878	1130.58	2743.38	2178.09	565.29	
6.0	0.36	54.0	5.98%	6.914	1124.62	2737.42	2175.11	562.31	
6.5	0.39	55.0	6.48%	6.951	1139.38	2752.18	2182.49	569.69	
7.0	0.42	55.0	6.98%	6.988	1133.31	2746.11	2179.45	566.65	
7.5	0.45	54.0	7.48%	7.026	1106.74	2719.54	2166.17	553.37	
8.0	0.48	53.0	7.97%	7.064	1080.39	2693.19	2153.00	540.20	
8.5	0.51	53.0	8.47%	7.103	1074.54	2687.34	2150.07	537.27	
9.0	0.54	52.0	8.97%	7.141	1048.53	2661.33	2137.06	524.26	
9.5	0.57	52.0	9.47%	7.181	1042.79	2655.59	2134.19	521.39	
10.0	0.60	51.0	9.97%	7.220	1017.11	2629.91	2121.35	508.55	
SIGMA 1 AT FAILURE:						2752.18			
TIME TO FAILURE, (min):		6.50		DATE		10/24/05			
DEFLECTION AT FAILURE, (in):		0.39		TECH		RMW			
STRAIN AT FAILURE:		6.48%		REVIEW		RMW			

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY



SAMPLE #: **RD-1 ST-2**
14'-16'

CONFINING PRES(psi)	11
MOIST DENSITY(pcf)	109.88
% MOISTURE	44.91%
STRAIN RATE(%/min)	1.00

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

DATE	10/24/05
TECH	RMW
REVIEW	RMW

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

UNCONSOLIDATED/UNDRAINED COMPRESSIVE STRENGTH OF SOILS

ASTM D 2850

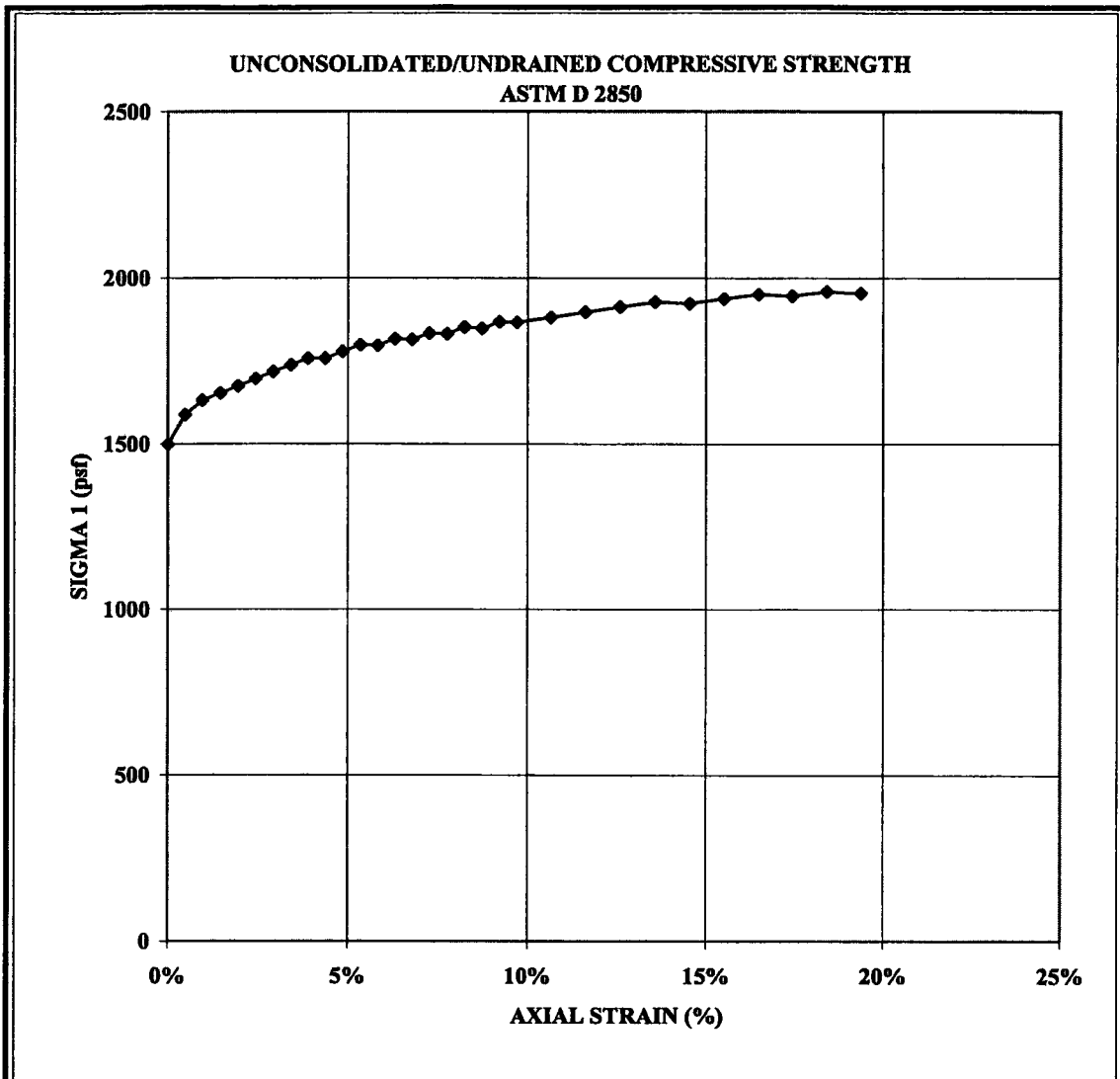
CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300					SAMPLE #: RD-2 ST-3 13'-15'			
SAMPLE DATA					SKETCH			
height (in)	6.194	confining pressure (psi)	10.4					
diameter (in)	2.845	machine speed (in/min)	0.06					
area (in ²)	6.357	strain rate (%/min)	0.97					
height/diameter ratio	2.18							
volume (in ³)	39.38	MOISTURE CONTENT						
weight (g)	1117.02	tare #	9					
specific gravity	2.70	wt soil&tare,moist (g)	1474.46					
moist density (pcf)	108.02	wt soil&tare,dry (g)	1090.82					
dry density (pcf)	70.99	wt tare (g)	355.45					
volume,solids (in ³)	16.59	wt moisture (g)	383.64					
volume,voids (in ³)	22.78	wt dry soil (g)	735.37					
% saturation	102.57%	% moisture	52.17%					

TIME (min)	DEFLECTION (in)	AXIAL LOAD (lbs)	STRAIN (%)	AREA,CORR (in ²)	DEVIATOR STRESS (psf)	SIGMA I (psf)	P (psf)	Q (psf)
0.0	0.00	0.0	0.00%	6.357	0.00	1497.6	1497.6	0
0.5	0.03	4.0	0.48%	6.388	90.17	1587.77	1542.68	45.08
1.0	0.06	6.0	0.97%	6.419	134.60	1632.20	1564.90	67.30
1.5	0.09	7.0	1.45%	6.451	156.26	1653.86	1575.73	78.13
2.0	0.12	8.0	1.94%	6.483	177.71	1675.31	1586.45	88.85
2.5	0.15	9.0	2.42%	6.515	198.93	1696.53	1597.07	99.47
3.0	0.18	10.0	2.91%	6.547	219.94	1717.54	1607.57	109.97
3.5	0.21	11.0	3.39%	6.580	240.72	1738.32	1617.96	120.36
4.0	0.24	12.0	3.87%	6.613	261.29	1758.89	1628.25	130.65
4.5	0.27	12.0	4.36%	6.647	259.98	1757.58	1627.59	129.99
5.0	0.30	13.0	4.84%	6.681	280.21	1777.81	1637.71	140.11
5.5	0.33	14.0	5.33%	6.715	300.23	1797.83	1647.72	150.12
6.0	0.36	14.0	5.81%	6.749	298.70	1796.30	1646.95	149.35
6.5	0.39	15.0	6.30%	6.784	318.39	1815.99	1656.79	159.19
7.0	0.42	15.0	6.78%	6.819	316.74	1814.34	1655.97	158.37
7.5	0.45	16.0	7.27%	6.855	336.10	1833.70	1665.65	168.05
8.0	0.48	16.0	7.75%	6.891	334.35	1831.95	1664.77	167.17
8.5	0.51	17.0	8.23%	6.927	353.38	1850.98	1674.29	176.69
9.0	0.54	17.0	8.72%	6.964	351.51	1849.11	1673.36	175.76
9.5	0.57	18.0	9.20%	7.001	370.22	1867.82	1682.71	185.11
10.0	0.60	18.0	9.69%	7.039	368.24	1865.84	1681.72	184.12
11.0	0.66	19.0	10.66%	7.115	384.53	1882.13	1689.86	192.26
12.0	0.72	20.0	11.62%	7.193	400.38	1897.98	1697.79	200.19
13.0	0.78	21.0	12.59%	7.273	415.79	1913.39	1705.50	207.90
14.0	0.84	22.0	13.56%	7.354	430.76	1928.36	1712.98	215.38
15.0	0.90	22.0	14.53%	7.438	425.94	1923.54	1710.57	212.97
16.0	0.96	23.0	15.50%	7.523	440.25	1937.85	1717.72	220.12
17.0	1.02	24.0	16.47%	7.610	454.12	1951.72	1724.66	227.06
18.0	1.08	24.0	17.44%	7.700	448.86	1946.46	1722.03	224.43
19.0	1.14	25.0	18.40%	7.791	462.07	1959.67	1728.64	231.04
20.0	1.20	25.0	19.37%	7.885	456.59	1954.19	1725.89	228.29

SIGMA I AT FAILURE:					1930.47
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TIME TO FAILURE, (min):	15.48		DATE	11/04/05
DEFLECTION AT FAILURE, (in):	0.87		TECH	RMW
STRAIN AT FAILURE:	15.00%		REVIEW	RMW

GOLDER ASSOCIATES INC.
 CHERRY HILL, NEW JERSEY



SAMPLE #: RD-2 ST-3
13'-15'

CONFINING PRES(psi)	10
MOIST DENSITY(pcf)	108.02
% MOISTURE	52.17%
STRAIN RATE(%/min)	0.97

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

DATE	11/04/05
TECH	RMW
REVIEW	RMW

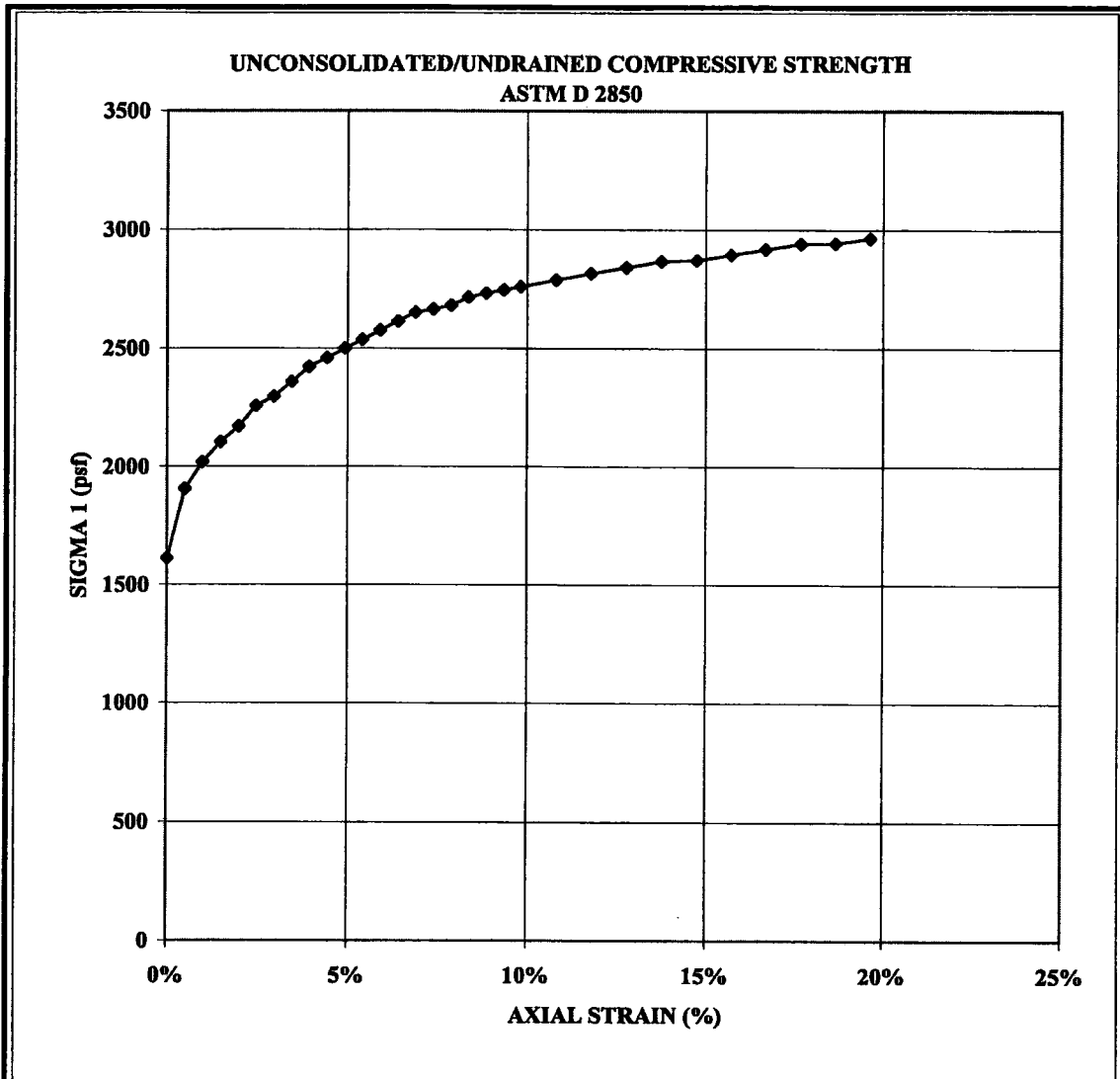
GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

UNCONSOLIDATED/UNDRAINED COMPRESSIVE STRENGTH OF SOILS

ASTM D 2850

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				SAMPLE #: RD-3 ST-2 14'-16'				
SAMPLE DATA						SKETCH		
height (in)	6.110	confining pressure (psi)	11.2					
diameter (in)	2.840	machine speed (in/min)	0.06					
area (in ²)	6.335	strain rate (%/min)	0.98					
height/diameter ratio	2.15							
volume (in ³)	38.71	MOISTURE CONTENT						
weight (g)	1145.06	tare #	84					
specific gravity	2.70	wt soil&tare,moist (g)	1479.18					
moist density (pcf)	112.65	wt soil&tare, dry (g)	1159.08					
dry density (pcf)	81.17	wt tare (g)	333.66					
volume, solids (in ³)	18.65	wt moisture (g)	320.10					
volume, voids (in ³)	20.06	wt dry soil (g)	825.42					
% saturation	97.35%	% moisture	38.78%					
TIME (min)	DEFLECTION (in)	AXIAL LOAD (lbs)	STRAIN (%)	AREA, CORR (in ²)	DEVIATOR STRESS (psf)	SIGMA 1 (psf)	P (psf)	Q (psf)
0.0	0.00	0.0	0.00%	6.335	0.00	1612.8	1612.8	0
0.5	0.03	13.0	0.49%	6.366	294.06	1906.86	1759.83	147.03
1.0	0.06	18.0	0.98%	6.398	405.16	2017.96	1815.38	202.58
1.5	0.09	22.0	1.47%	6.429	492.74	2105.54	1859.17	246.37
2.0	0.12	25.0	1.96%	6.462	557.14	2169.94	1891.37	278.57
2.5	0.15	29.0	2.45%	6.494	643.04	2255.84	1934.32	321.52
3.0	0.18	31.0	2.95%	6.527	683.93	2296.73	1954.76	341.96
3.5	0.21	34.0	3.44%	6.560	746.32	2359.12	1985.96	373.16
4.0	0.24	37.0	3.93%	6.594	808.04	2420.84	2016.82	404.02
4.5	0.27	39.0	4.42%	6.628	847.37	2460.17	2036.48	423.68
5.0	0.30	41.0	4.91%	6.662	886.25	2499.05	2055.92	443.12
5.5	0.33	43.0	5.40%	6.696	924.68	2537.48	2075.14	462.34
6.0	0.36	45.0	5.89%	6.731	962.66	2575.46	2094.13	481.33
6.5	0.39	47.0	6.38%	6.767	1000.20	2613.00	2112.90	500.10
7.0	0.42	49.0	6.87%	6.802	1037.30	2650.10	2131.45	518.65
7.5	0.45	50.0	7.36%	6.838	1052.89	2665.69	2139.24	526.44
8.0	0.48	51.0	7.86%	6.875	1068.25	2681.05	2146.93	534.13
8.5	0.51	53.0	8.35%	6.912	1104.23	2717.03	2164.91	552.11
9.0	0.54	54.0	8.84%	6.949	1119.03	2731.83	2172.32	559.52
9.5	0.57	55.0	9.33%	6.986	1133.62	2746.42	2179.61	566.81
10.0	0.60	56.0	9.82%	7.025	1147.98	2760.78	2186.79	573.99
11.0	0.66	58.0	10.80%	7.102	1176.03	2788.83	2200.82	588.02
12.0	0.72	60.0	11.78%	7.181	1203.19	2815.99	2214.40	601.60
13.0	0.78	62.0	12.77%	7.262	1229.46	2842.26	2227.53	614.73
14.0	0.84	64.0	13.75%	7.344	1254.83	2867.63	2240.22	627.42
15.0	0.90	65.0	14.73%	7.429	1259.93	2872.73	2242.76	629.96
16.0	0.96	67.0	15.71%	7.516	1283.74	2896.54	2254.67	641.87
17.0	1.02	69.0	16.69%	7.604	1306.66	2919.46	2266.13	653.33
18.0	1.08	71.0	17.68%	7.695	1328.68	2941.48	2277.14	664.34
19.0	1.14	72.0	18.66%	7.788	1331.32	2944.12	2278.46	665.66
20.0	1.20	74.0	19.64%	7.883	1351.79	2964.59	2288.69	675.89
SIGMA 1 AT FAILURE:						2879.29		
TIME TO FAILURE, (min):		15.28		DATE:		11/04/05		
DEFLECTION AT FAILURE, (in):		0.92		TECH:		RMW		
STRAIN AT FAILURE:		15.00%		REVIEW:		RMW		

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY



SAMPLE #: **RD-3 ST-2**
14'-16'

CONFINING PRES(psi)	11
MOIST DENSITY(pcf)	112.65
% MOISTURE	38.78%
STRAIN RATE(%/min)	0.98

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

DATE	11/04/05
TECH	RMW
REVIEW	RMW

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

UNCONSOLIDATED/UNDRAINED COMPRESSIVE STRENGTH OF SOILS

ASTM D 2850

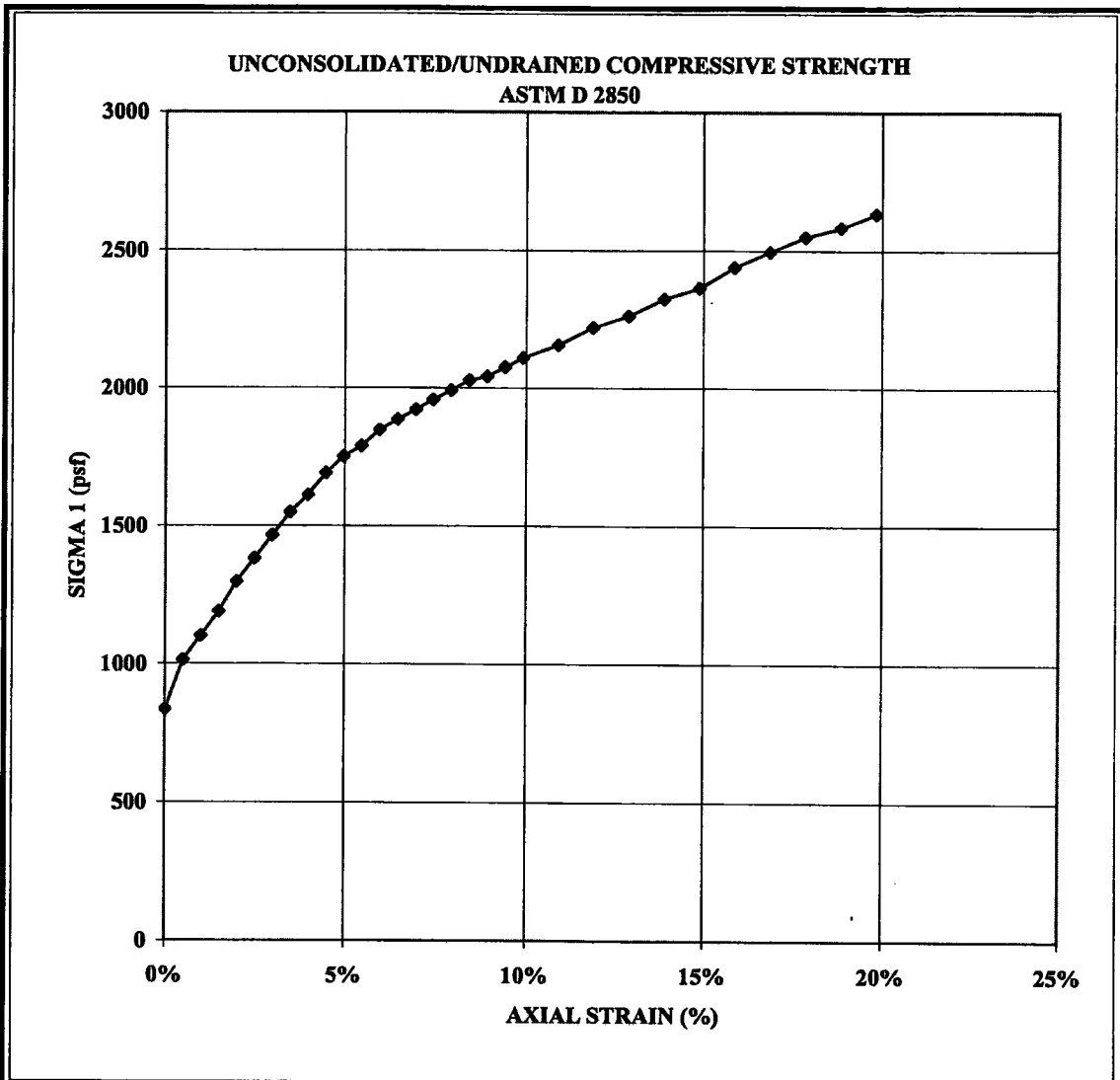
CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				SAMPLE #: RD-4 ST-2 6'-8'				
SAMPLE DATA						SKETCH		
height (in)	4.942	confining pressure (psi)	5.8					
diameter (in)	2.858	machine speed (in/min)	0.05					
area (in²)	6.415	strain rate (%/min)	0.99					
height/diameter ratio	1.73							
volume (in³)	31.70	MOISTURE CONTENT						
weight (g)	1083.11	tare #	89					
specific gravity	2.70	wt soil&tare, moist (g)	1436.72					
moist density (pcf)	130.09	wt soil&tare, dry (g)	1243.63					
dry density (pcf)	106.86	wt tare (g)	355.37					
volume, solids (in³)	20.11	wt moisture (g)	193.09					
volume, voids (in³)	11.60	wt dry soil (g)	888.26					
% saturation	101.78%	% moisture	21.74%					

TIME (min)	DEFLECTION (in)	AXIAL LOAD (lbs)	STRAIN (ε)	AREA, CORR (in²)	DEVIATOR STRESS (psf)	SIGMA I (psf)	P (psf)	Q (psf)
0.0	0.00	0.0	0.00%	6.415	0.00	835.2	835.2	0
0.5	0.02	8.0	0.50%	6.447	178.68	1013.88	924.54	89.34
1.0	0.05	12.0	0.99%	6.480	266.69	1101.89	968.54	133.34
1.5	0.07	16.0	1.49%	6.512	353.80	1189.00	1012.10	176.90
2.0	0.10	21.0	1.98%	6.545	462.03	1297.23	1066.21	231.01
2.5	0.12	25.0	2.48%	6.578	547.25	1382.45	1108.83	273.63
3.0	0.15	29.0	2.97%	6.612	631.59	1466.79	1150.99	315.79
3.5	0.17	33.0	3.47%	6.646	715.03	1550.23	1192.71	357.51
4.0	0.20	36.0	3.97%	6.680	776.02	1611.22	1223.21	388.01
4.5	0.22	40.0	4.46%	6.715	857.80	1693.00	1264.10	428.90
5.0	0.25	43.0	4.96%	6.750	917.35	1752.55	1293.87	458.67
5.5	0.27	45.0	5.45%	6.785	955.01	1790.21	1312.70	477.50
6.0	0.29	48.0	5.95%	6.821	1013.33	1848.53	1341.87	506.67
6.5	0.32	50.0	6.44%	6.857	1049.99	1885.19	1360.20	525.00
7.0	0.34	52.0	6.94%	6.894	1086.21	1921.41	1378.30	543.10
7.5	0.37	54.0	7.44%	6.931	1121.97	1957.17	1396.19	560.99
8.0	0.39	56.0	7.93%	6.968	1157.30	1992.50	1413.85	578.65
8.5	0.42	58.0	8.43%	7.006	1192.17	2027.37	1431.29	596.09
9.0	0.44	59.0	8.92%	7.044	1206.16	2041.36	1438.28	603.08
9.5	0.47	61.0	9.42%	7.082	1240.26	2075.46	1455.33	620.13
10.0	0.49	63.0	9.92%	7.121	1273.92	2109.12	1472.16	636.96
11.0	0.54	66.0	10.91%	7.201	1319.89	2155.09	1495.15	659.95
12.0	0.59	70.0	11.90%	7.282	1384.31	2219.51	1527.35	692.15
13.0	0.64	73.0	12.89%	7.365	1427.39	2262.59	1548.89	713.69
14.0	0.69	77.0	13.88%	7.449	1488.46	2323.66	1579.43	744.23
15.0	0.74	80.0	14.87%	7.536	1528.65	2363.85	1599.52	764.32
16.0	0.78	85.0	15.86%	7.625	1605.27	2440.47	1637.84	802.64
17.0	0.83	89.0	16.86%	7.716	1661.01	2496.21	1665.70	830.50
18.0	0.88	93.0	17.85%	7.809	1714.96	2550.16	1692.68	857.48
19.0	0.93	96.0	18.84%	7.904	1748.92	2584.12	1709.66	874.46
20.0	0.98	100.0	19.83%	8.002	1799.53	2634.73	1734.97	899.77

SIGMA I AT FAILURE:				2373.91
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TIME TO FAILURE, (min):	15.13		DATE	11/03/05
DEFLECTION AT FAILURE, (in):	0.75		TECH	RMW
STRAIN AT FAILURE:	15.00%		REVIEW	RMW

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY



SAMPLE #: RD-4 ST-2
6'-8'

CONFINING PRES(psi)	6
MOIST DENSITY(pcf)	130.09
% MOISTURE	21.74%
STRAIN RATE(%/min)	0.99

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

DATE	11/03/05
TECH	RMW
REVIEW	RMW

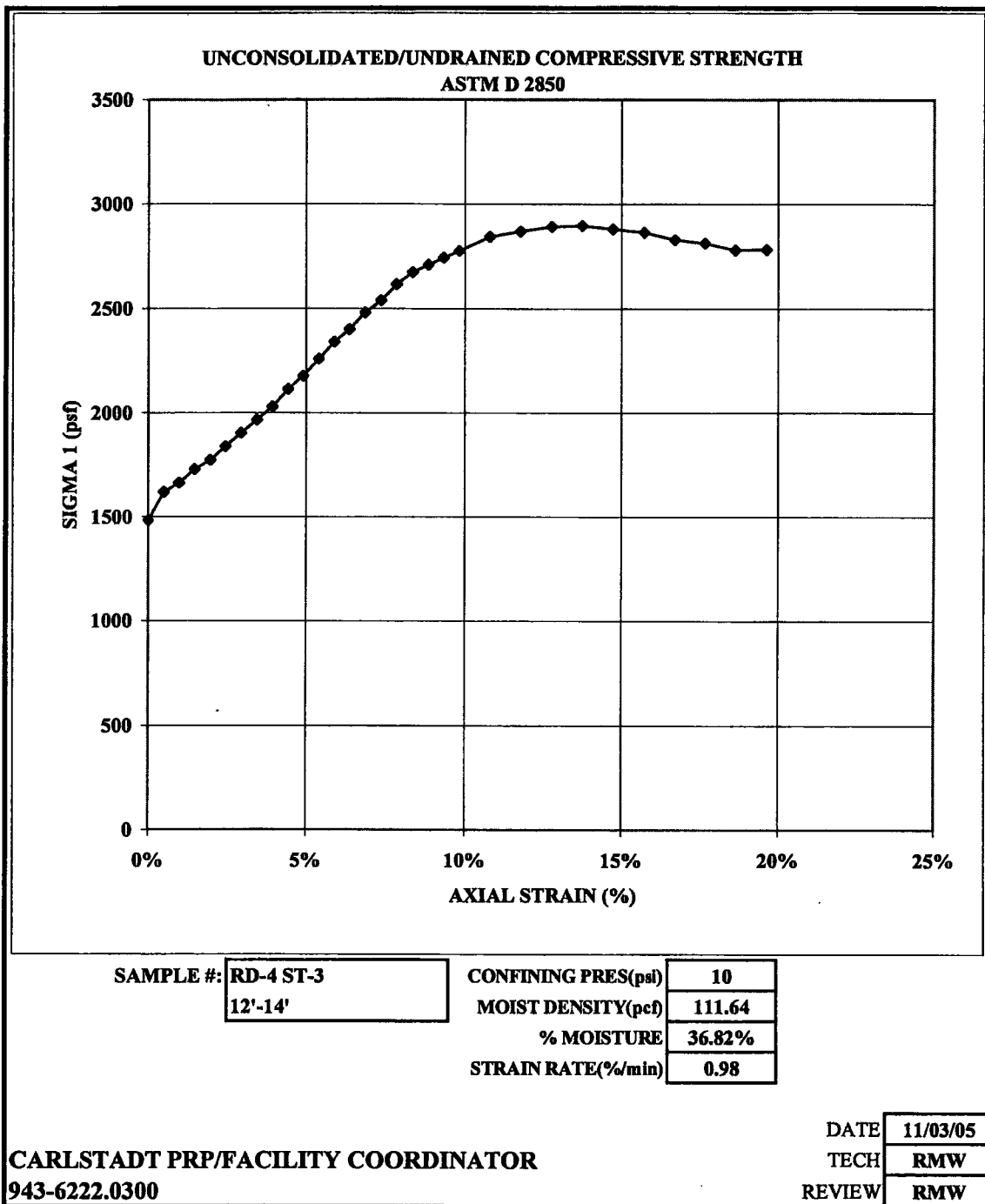
GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

UNCONSOLIDATED/UNDRAINED COMPRESSIVE STRENGTH OF SOILS

ASTM D 2850

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300					SAMPLE #: RD-4 ST-3 12'-14'							
<table style="width:100%; border: none;"> <tr> <td style="width:35%; vertical-align: top; border: none;"> SAMPLE DATA height (in) 6.113 diameter (in) 2.837 area (in²) 6.321 height/diameter ratio 2.15 volume (in³) 38.64 weight (g) 1132.88 specific gravity 2.70 moist density (pcf) 111.64 dry density (pcf) 81.60 volume, solids (in³) 18.71 volume, voids (in³) 19.93 % saturation 93.35% </td> <td style="width:35%; vertical-align: top; border: none;"> confining pressure (psi) 10.3 machine speed (in/min) 0.06 strain rate (%/min) 0.98 MOISTURE CONTENT tare # 92 wt soil&tare, moist (g) 1479.59 wt soil&tare, dry (g) 1175.19 wt tare (g) 348.39 wt moisture (g) 304.40 wt dry soil (g) 826.80 % moisture 36.82% </td> <td style="width:30%; vertical-align: top; border: none;"> SKETCH <div style="height: 100px;"></div> </td> </tr> </table>										SAMPLE DATA height (in) 6.113 diameter (in) 2.837 area (in ²) 6.321 height/diameter ratio 2.15 volume (in ³) 38.64 weight (g) 1132.88 specific gravity 2.70 moist density (pcf) 111.64 dry density (pcf) 81.60 volume, solids (in ³) 18.71 volume, voids (in ³) 19.93 % saturation 93.35%	confining pressure (psi) 10.3 machine speed (in/min) 0.06 strain rate (%/min) 0.98 MOISTURE CONTENT tare # 92 wt soil&tare, moist (g) 1479.59 wt soil&tare, dry (g) 1175.19 wt tare (g) 348.39 wt moisture (g) 304.40 wt dry soil (g) 826.80 % moisture 36.82%	SKETCH <div style="height: 100px;"></div>
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TIME (min)	DEFLECTION (in)	AXIAL LOAD (lbs)	STRAIN (%)	AREA, CORR (in ²)	DEVIATOR STRESS (psf)	SIGMA 1 (psf)	P (psf)	Q (psf)				
0.0	0.00	0.0	0.00%	6.321	0.00	1483.2	1483.2	0				
0.5	0.03	6.0	0.49%	6.353	136.01	1619.21	1551.20	68.00				
1.0	0.06	8.0	0.98%	6.384	180.45	1663.65	1573.43	90.23				
1.5	0.09	11.0	1.47%	6.416	246.89	1730.09	1606.65	123.45				
2.0	0.12	13.0	1.96%	6.448	290.33	1773.53	1628.36	145.16				
2.5	0.15	16.0	2.45%	6.480	355.54	1838.74	1660.97	177.77				
3.0	0.18	19.0	2.94%	6.513	420.08	1903.28	1693.24	210.04				
3.5	0.21	22.0	3.44%	6.546	483.94	1967.14	1725.17	241.97				
4.0	0.24	25.0	3.93%	6.580	547.14	2030.34	1756.77	273.57				
4.5	0.27	29.0	4.42%	6.613	631.44	2114.64	1798.92	315.72				
5.0	0.30	32.0	4.91%	6.648	693.19	2176.39	1829.79	346.59				
5.5	0.33	36.0	5.40%	6.682	775.81	2259.01	1871.10	387.90				
6.0	0.36	40.0	5.89%	6.717	857.54	2340.74	1911.97	428.77				
6.5	0.39	43.0	6.38%	6.752	917.05	2400.25	1941.72	458.52				
7.0	0.42	47.0	6.87%	6.788	997.10	2480.30	1981.75	498.55				
7.5	0.45	50.0	7.36%	6.824	1055.15	2538.35	2010.78	527.58				
8.0	0.48	54.0	7.85%	6.860	1133.53	2616.73	2049.97	566.77				
8.5	0.51	57.0	8.34%	6.897	1190.13	2673.33	2078.27	595.07				
9.0	0.54	59.0	8.83%	6.934	1225.29	2708.49	2095.85	612.65				
9.5	0.57	61.0	9.32%	6.971	1260.01	2743.21	2113.21	630.01				
10.0	0.60	63.0	9.82%	7.009	1294.28	2777.48	2130.34	647.14				
11.0	0.66	67.0	10.80%	7.086	1361.48	2844.68	2163.94	680.74				
12.0	0.72	69.0	11.78%	7.165	1386.69	2869.89	2176.54	693.34				
13.0	0.78	71.0	12.76%	7.246	1411.01	2894.21	2188.70	705.50				
14.0	0.84	72.0	13.74%	7.328	1414.78	2897.98	2190.59	707.39				
15.0	0.90	72.0	14.72%	7.413	1398.68	2881.88	2182.54	699.34				
16.0	0.96	72.0	15.70%	7.499	1382.59	2865.79	2174.49	691.29				
17.0	1.02	71.0	16.69%	7.587	1347.51	2830.71	2156.95	673.75				
18.0	1.08	71.0	17.67%	7.678	1331.63	2814.83	2149.02	665.82				
19.0	1.14	70.0	18.65%	7.770	1297.23	2780.43	2131.81	648.61				
20.0	1.20	71.0	19.63%	7.865	1299.88	2783.08	2133.14	649.94				
SIGMA 1 AT FAILURE:						2897.98						
TIME TO FAILURE, (min):		14.00		DATE		11/03/05						
DEFLECTION AT FAILURE, (in):		0.84		TECH		RMW						
STRAIN AT FAILURE:		13.74%		REVIEW		RMW						

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY



GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

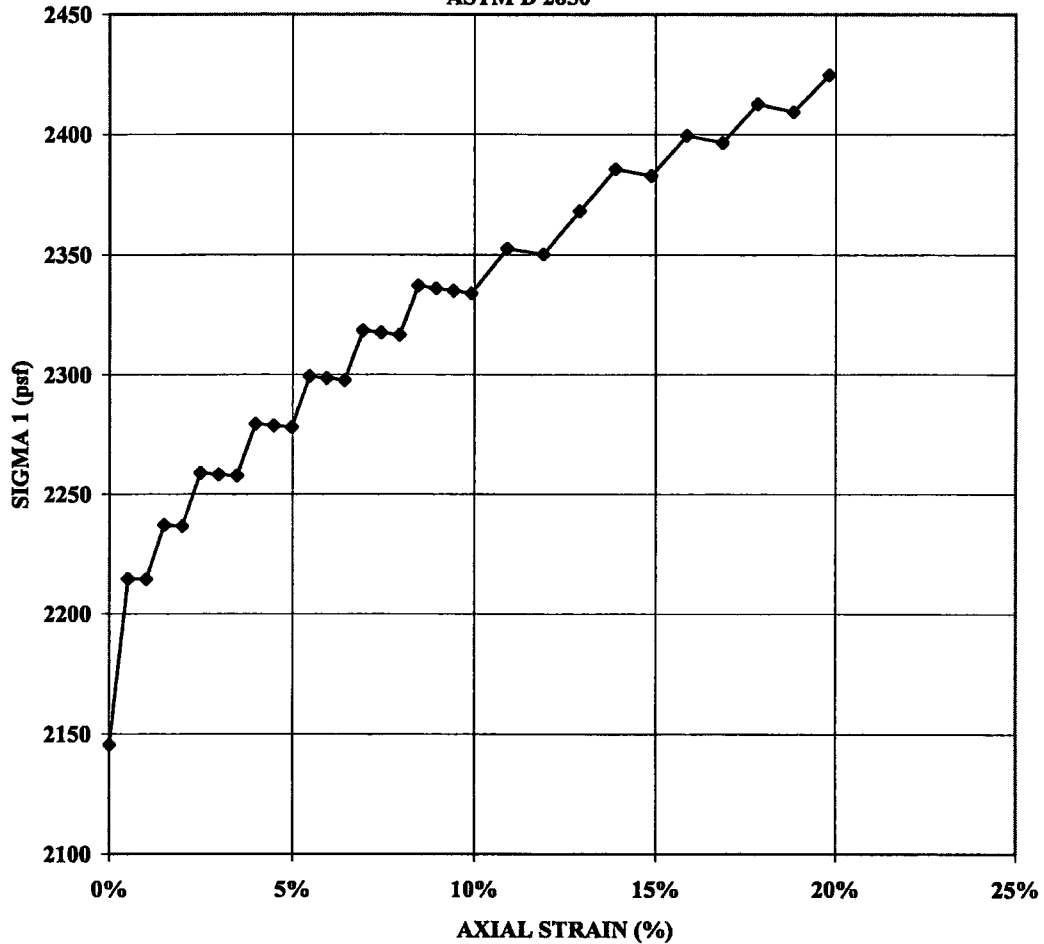
UNCONSOLIDATED/UNDRAINED COMPRESSIVE STRENGTH OF SOILS

ASTM D 2850

CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300					SAMPLE #: RD-4 ST-4 18'-20'																																																								
<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> SAMPLE DATA <table border="1" style="width:100%; border-collapse: collapse; font-size: 0.8em;"> <tr><td>height (in)</td><td>6.053</td><td>confining pressure (psi)</td><td>14.9</td></tr> <tr><td>diameter (in)</td><td>2.810</td><td>machine speed (in/min)</td><td>0.06</td></tr> <tr><td>area (in²)</td><td>6.202</td><td>strain rate (%/min)</td><td>0.99</td></tr> <tr><td>height/diameter ratio</td><td>2.15</td><td></td><td></td></tr> <tr><td>volume (in³)</td><td>37.54</td><td></td><td></td></tr> <tr><td>weight (g)</td><td>1201.11</td><td>MOISTURE CONTENT</td><td></td></tr> <tr><td>specific gravity</td><td>2.70</td><td>tare #</td><td>86</td></tr> <tr><td>moist density (pcf)</td><td>121.84</td><td>wt soil&tare, moist (g)</td><td>1526.07</td></tr> <tr><td>dry density (pcf)</td><td>87.97</td><td>wt soil&tare, dry (g)</td><td>1194.47</td></tr> <tr><td>volume, solids (in³)</td><td>19.60</td><td>wt tare (g)</td><td>333.08</td></tr> <tr><td>volume, voids (in³)</td><td>17.94</td><td>wt moisture (g)</td><td>331.60</td></tr> <tr><td>% saturation</td><td>113.58%</td><td>wt dry soil (g)</td><td>861.39</td></tr> <tr><td></td><td></td><td>% moisture</td><td>38.50%</td></tr> </table> </div> <div style="width: 35%; text-align: center;"> SKETCH </div> </div>										height (in)	6.053	confining pressure (psi)	14.9	diameter (in)	2.810	machine speed (in/min)	0.06	area (in ²)	6.202	strain rate (%/min)	0.99	height/diameter ratio	2.15			volume (in ³)	37.54			weight (g)	1201.11	MOISTURE CONTENT		specific gravity	2.70	tare #	86	moist density (pcf)	121.84	wt soil&tare, moist (g)	1526.07	dry density (pcf)	87.97	wt soil&tare, dry (g)	1194.47	volume, solids (in ³)	19.60	wt tare (g)	333.08	volume, voids (in ³)	17.94	wt moisture (g)	331.60	% saturation	113.58%	wt dry soil (g)	861.39			% moisture	38.50%
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TIME	DEFLECTION	AXIAL	STRAIN	AREA, CORR	DEVIATOR	SIGMA 1	P	Q																																																					
(min)	(in)	LOAD (lbs)	(%)	(in ²)	STRESS (psf)	(psf)	(psf)	(psf)																																																					
0.0	0.00	0.0	0.00%	6.202	0.00	2145.6	2145.6	0																																																					
0.5	0.03	3.0	0.50%	6.232	69.31	2214.91	2180.26	34.66																																																					
1.0	0.06	3.0	0.99%	6.264	68.97	2214.57	2180.08	34.48																																																					
1.5	0.09	4.0	1.49%	6.295	91.50	2237.10	2191.35	45.75																																																					
2.0	0.12	4.0	1.98%	6.327	91.04	2236.64	2191.12	45.52																																																					
2.5	0.15	5.0	2.48%	6.359	113.22	2258.82	2202.21	56.61																																																					
3.0	0.18	5.0	2.97%	6.392	112.65	2258.25	2201.92	56.32																																																					
3.5	0.21	5.0	3.47%	6.424	112.07	2257.67	2201.64	56.04																																																					
4.0	0.24	6.0	3.96%	6.458	133.80	2279.40	2212.50	66.90																																																					
4.5	0.27	6.0	4.46%	6.491	133.10	2278.70	2212.15	66.55																																																					
5.0	0.30	6.0	4.96%	6.525	132.41	2278.01	2211.81	66.21																																																					
5.5	0.33	7.0	5.45%	6.559	153.68	2299.28	2222.44	76.84																																																					
6.0	0.36	7.0	5.95%	6.594	152.87	2298.47	2222.04	76.44																																																					
6.5	0.39	7.0	6.44%	6.629	152.07	2297.67	2221.63	76.03																																																					
7.0	0.42	8.0	6.94%	6.664	172.87	2318.47	2232.03	86.43																																																					
7.5	0.45	8.0	7.43%	6.700	171.95	2317.55	2231.57	85.97																																																					
8.0	0.48	8.0	7.93%	6.736	171.03	2316.63	2231.11	85.51																																																					
8.5	0.51	9.0	8.43%	6.772	191.37	2336.97	2241.29	95.69																																																					
9.0	0.54	9.0	8.92%	6.809	190.34	2335.94	2240.77	95.17																																																					
9.5	0.57	9.0	9.42%	6.846	189.30	2334.90	2240.25	94.65																																																					
10.0	0.60	9.0	9.91%	6.884	188.26	2333.86	2239.73	94.13																																																					
11.0	0.66	10.0	10.90%	6.961	206.88	2352.48	2249.04	103.44																																																					
12.0	0.72	10.0	11.89%	7.039	204.58	2350.18	2247.89	102.29																																																					
13.0	0.78	11.0	12.89%	7.119	222.50	2368.10	2256.85	111.25																																																					
14.0	0.84	12.0	13.88%	7.201	239.97	2385.57	2265.59	119.99																																																					
15.0	0.90	12.0	14.87%	7.285	237.21	2382.81	2264.20	118.60																																																					
16.0	0.96	13.0	15.86%	7.371	253.98	2399.58	2272.59	126.99																																																					
17.0	1.02	13.0	16.85%	7.458	250.99	2396.59	2271.10	125.50																																																					
18.0	1.08	14.0	17.84%	7.548	267.08	2412.68	2279.14	133.54																																																					
19.0	1.14	14.0	18.83%	7.641	263.85	2409.45	2277.53	131.93																																																					
20.0	1.20	15.0	19.82%	7.735	279.25	2424.85	2285.22	139.62																																																					
SIGMA 1 AT FAILURE:						2385.01																																																							
TIME TO FAILURE, (min):		15.13		DATE		11/04/05																																																							
DEFLECTION AT FAILURE, (in):		0.91		TECH		RMW																																																							
STRAIN AT FAILURE:		15.00%		REVIEW		RMW																																																							

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

**UNCONSOLIDATED/UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850**



SAMPLE #: RD-4 ST-4
18'-20'

CONFINING PRES(psi)	15
MOIST DENSITY(pcf)	121.84
% MOISTURE	38.50%
STRAIN RATE(%/min)	0.99

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

DATE	11/04/05
TECH	RMW
REVIEW	RMW

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

UNCONSOLIDATED/UNDRAINED COMPRESSIVE STRENGTH OF SOILS

ASTM D 2850

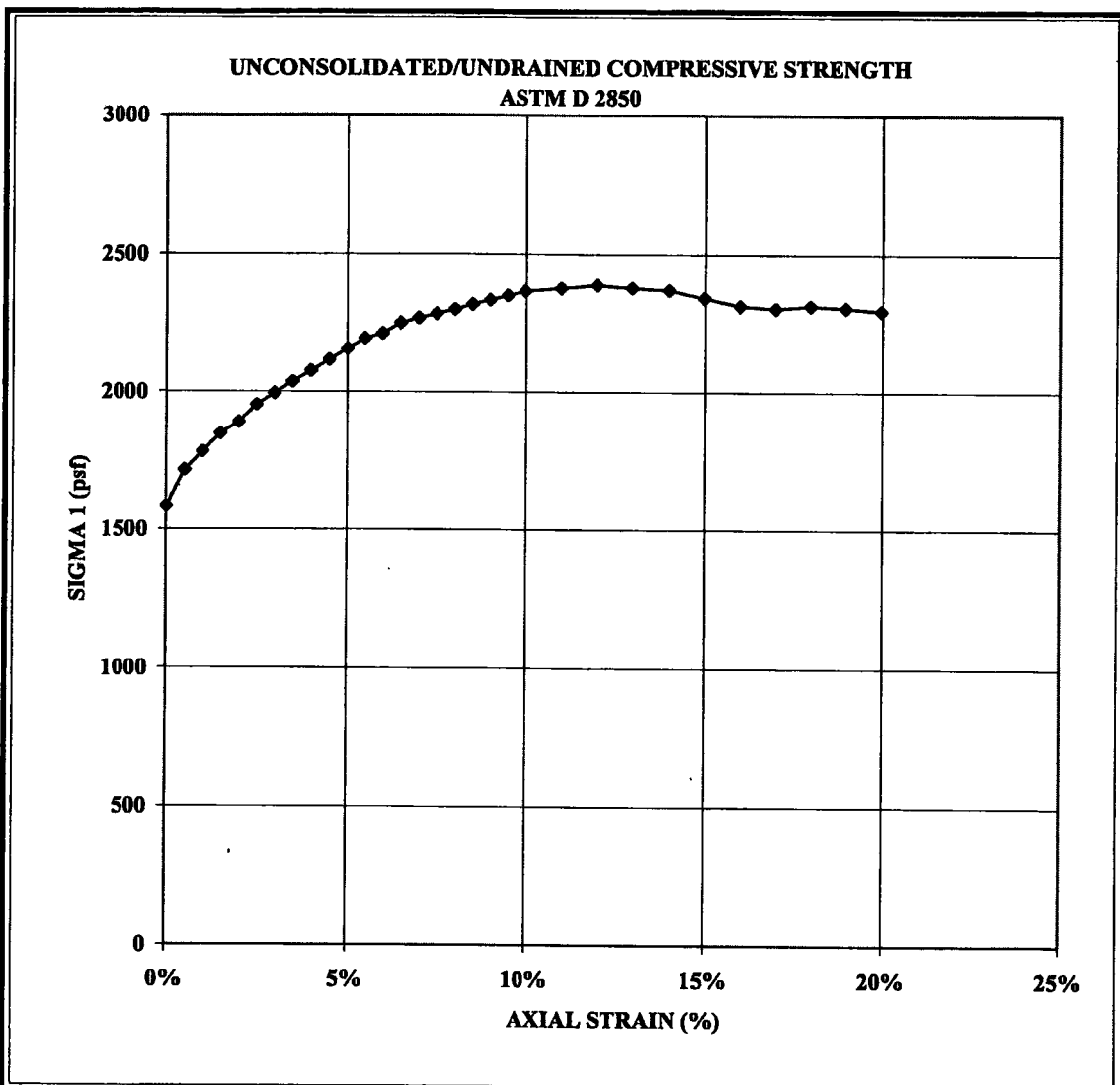
CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300					SAMPLE #: RD-5 ST-3 14'-16'				
SAMPLE DATA					SKETCH				
height (in)	6.014	confining pressure (psi)	11.0						
diameter (in)	2.870	machine speed (in/min)	0.06						
area (in ²)	6.469	strain rate (%/min)	1.00						
height/diameter ratio	2.10								
volume (in ³)	38.91	MOISTURE CONTENT							
weight (g)	1165.56	tare #	25						
specific gravity	2.70	wt soil&tare, moist (g)	1504.52						
moist density (pcf)	114.08	wt soil&tare, dry (g)	1163.66						
dry density (pcf)	80.70	wt tare (g)	339.58						
volume, solids (in ³)	18.64	wt moisture (g)	340.86						
volume, voids (in ³)	20.27	wt dry soil (g)	824.08						
% saturation	102.67%	% moisture	41.36%						

TIME (min)	DEFLECTION (in)	AXIAL LOAD (lbs)	STRAIN (%)	AREA, CORR (in ²)	DEVIATOR STRESS (psf)	SIGMA 1 (psf)	P (psf)	Q (psf)
0.0	0.00	0.0	0.00%	6.469	0.00	1584	1584	0
0.5	0.03	6.0	0.50%	6.502	132.89	1716.89	1650.44	66.44
1.0	0.06	9.0	1.00%	6.534	198.33	1782.33	1683.17	99.17
1.5	0.09	12.0	1.50%	6.568	263.11	1847.11	1715.56	131.56
2.0	0.12	14.0	2.00%	6.601	305.41	1889.41	1736.71	152.71
2.5	0.15	17.0	2.49%	6.635	368.97	1952.97	1768.48	184.48
3.0	0.18	19.0	2.99%	6.669	410.27	1994.27	1789.13	205.13
3.5	0.21	21.0	3.49%	6.703	451.12	2035.12	1809.56	225.56
4.0	0.24	23.0	3.99%	6.738	491.53	2075.53	1829.76	245.76
4.5	0.27	25.0	4.49%	6.773	531.50	2115.50	1849.75	265.75
5.0	0.30	27.0	4.99%	6.809	571.02	2155.02	1869.51	285.51
5.5	0.33	29.0	5.49%	6.845	610.09	2194.09	1889.05	305.05
6.0	0.36	30.0	5.99%	6.881	627.80	2211.80	1897.90	313.90
6.5	0.39	32.0	6.48%	6.918	666.10	2250.10	1917.05	333.05
7.0	0.42	33.0	6.98%	6.955	683.25	2267.25	1925.63	341.63
7.5	0.45	34.0	7.48%	6.992	700.18	2284.18	1934.09	350.09
8.0	0.48	35.0	7.98%	7.030	716.89	2300.89	1942.45	358.45
8.5	0.51	36.0	8.48%	7.069	733.38	2317.38	1950.69	366.69
9.0	0.54	37.0	8.98%	7.107	749.64	2333.64	1958.82	374.82
9.5	0.57	38.0	9.48%	7.147	765.68	2349.68	1966.84	382.84
10.0	0.60	39.0	9.98%	7.186	781.50	2365.50	1974.75	390.75
11.0	0.66	40.0	10.97%	7.267	792.65	2376.65	1980.33	396.33
12.0	0.72	41.0	11.97%	7.349	803.37	2387.37	1985.68	401.68
13.0	0.78	41.0	12.97%	7.433	794.26	2378.26	1981.13	397.13
14.0	0.84	41.0	13.97%	7.520	785.16	2369.16	1976.58	392.58
15.0	0.90	40.0	14.97%	7.608	757.12	2341.12	1962.56	378.56
16.0	0.96	39.0	15.96%	7.698	729.53	2313.53	1948.77	364.77
17.0	1.02	39.0	16.96%	7.791	720.87	2304.87	1944.44	360.44
18.0	1.08	40.0	17.96%	7.885	730.47	2314.47	1949.24	365.24
19.0	1.14	40.0	18.96%	7.982	721.59	2305.59	1944.80	360.80
20.0	1.20	40.0	19.95%	8.082	712.71	2296.71	1940.35	356.35

SIGMA 1 AT FAILURE:					2387.37
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TIME TO FAILURE, (min):	12.00			DATE	11/04/05
DEFLECTION AT FAILURE, (in):	0.72			TECH	RMW
STRAIN AT FAILURE:	11.97%			REVIEW	RMW

GOLDER ASSOCIATES INC.
 CHERRY HILL, NEW JERSEY



SAMPLE #: RD-5 ST-3
14'-16'

CONFINING PRES(psf)	11
MOIST DENSITY(pcf)	114.08
% MOISTURE	41.36%
STRAIN RATE(%/min)	1.00

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

DATE	11/04/05
TECH	RMW
REVIEW	RMW

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

UNCONSOLIDATED/UNDRAINED COMPRESSIVE STRENGTH OF SOILS

ASTM D 2850

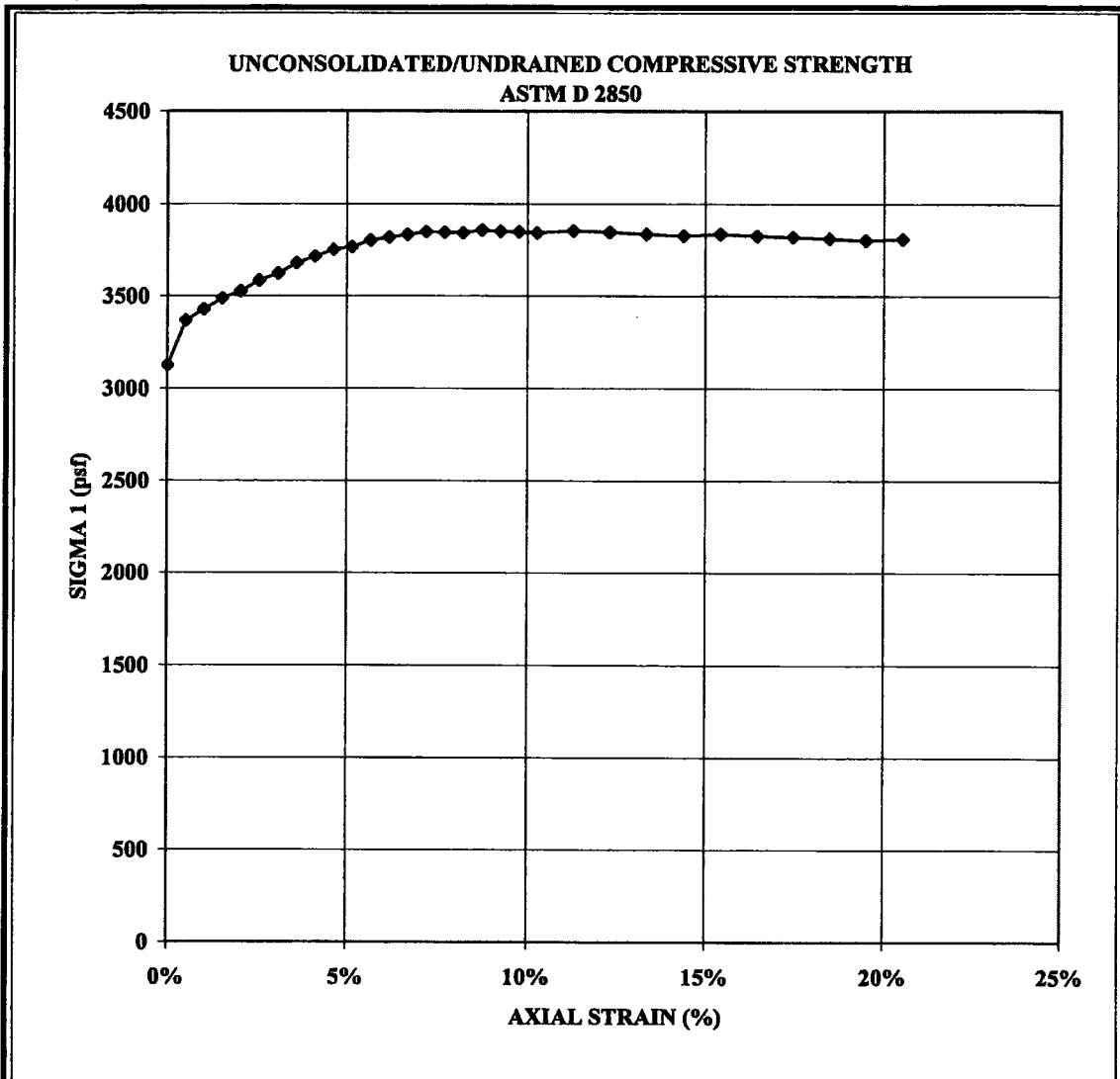
CARLSTADT PRP/FACILITY COORDINATOR 943-6222.0300				SAMPLE #: RD-5 ST-5 28'-30'			
SAMPLE DATA						SKETCH	
height (in)	5.846	confining pressure (psi)	21.7				
diameter (in)	2.986	machine speed (in/min)	0.06				
area (in²)	7.003	strain rate (%/min)	1.03				
height/diameter ratio	1.96						
volume (in³)	40.94	MOISTURE CONTENT					
weight (g)	1115.04	tare #	80				
specific gravity	2.70	wt soil&tare,moist (g)	1456.52				
moist density (pcf)	103.72	wt soil&tare,dry (g)	1107.41				
dry density (pcf)	71.19	wt tare (g)	343.26				
volume,solids (in³)	17.30	wt moisture (g)	349.11				
volume,voids (in³)	23.64	wt dry soil (g)	764.15				
% saturation	90.26%	% moisture	45.69%				

TIME (min)	DEPLECTION (in)	AXIAL LOAD (lbs)	STRAIN (%)	AREA,CORR (in²)	DEVIATOR STRESS (psf)	SIGMA 1 (psf)	P (psf)	Q (psf)
0.0	0.00	0.0	0.00%	7.003	0.00	3124.8	3124.8	0
0.5	0.03	12.0	0.51%	7.039	245.49	3370.29	3247.55	122.75
1.0	0.06	15.0	1.03%	7.075	305.28	3430.08	3277.44	152.64
1.5	0.09	18.0	1.54%	7.112	364.44	3489.24	3307.02	182.22
2.0	0.12	20.0	2.05%	7.150	402.82	3527.62	3326.21	201.41
2.5	0.15	23.0	2.57%	7.187	460.82	3585.62	3355.21	230.41
3.0	0.18	25.0	3.08%	7.225	498.25	3623.05	3373.93	249.13
3.5	0.21	28.0	3.59%	7.264	555.09	3679.89	3402.34	277.54
4.0	0.24	30.0	4.11%	7.303	591.57	3716.37	3420.59	295.79
4.5	0.27	32.0	4.62%	7.342	627.63	3752.43	3438.62	313.82
5.0	0.30	33.0	5.13%	7.382	643.77	3768.57	3446.68	321.88
5.5	0.33	35.0	5.64%	7.422	679.09	3803.89	3464.34	339.54
6.0	0.36	36.0	6.16%	7.462	694.69	3819.49	3472.15	347.35
6.5	0.39	37.0	6.67%	7.503	710.08	3834.88	3479.84	355.04
7.0	0.42	38.0	7.18%	7.545	725.27	3850.07	3487.43	362.63
7.5	0.45	38.0	7.70%	7.587	721.26	3846.06	3485.43	360.63
8.0	0.48	38.0	8.21%	7.629	717.25	3842.05	3483.42	358.62
8.5	0.51	39.0	8.72%	7.672	732.01	3856.81	3490.80	366.00
9.0	0.54	39.0	9.24%	7.715	727.89	3852.69	3488.75	363.95
9.5	0.57	39.0	9.75%	7.759	723.78	3848.58	3486.69	361.89
10.0	0.60	39.0	10.26%	7.804	719.66	3844.46	3484.63	359.83
11.0	0.66	40.0	11.29%	7.894	729.67	3854.47	3489.64	364.84
12.0	0.72	40.0	12.32%	7.986	721.23	3846.03	3485.41	360.61
13.0	0.78	40.0	13.34%	8.081	712.79	3837.59	3481.19	356.39
14.0	0.84	40.0	14.37%	8.178	704.34	3829.14	3476.97	352.17
15.0	0.90	41.0	15.40%	8.277	713.30	3838.10	3481.45	356.65
16.0	0.96	41.0	16.42%	8.379	704.65	3829.45	3477.12	352.32
17.0	1.02	41.0	17.45%	8.483	695.99	3820.79	3472.80	348.00
18.0	1.08	41.0	18.47%	8.590	687.34	3812.14	3468.47	343.67
19.0	1.14	41.0	19.50%	8.699	678.69	3803.49	3464.14	339.34
20.0	1.20	42.0	20.53%	8.811	686.38	3811.18	3467.99	343.19

SIGMA 1 AT FAILURE:				3854.47
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TIME TO FAILURE, (min):	11.00	DATE	11/03/05
DEFLECTION AT FAILURE, (in):	0.66	TECH	RMW
STRAIN AT FAILURE:	11.29%	REVIEW	RMW

GOLDER ASSOCIATES INC.
 CHERRY HILL, NEW JERSEY



SAMPLE #: **RD-5 ST-5**
28'-30'

CONFINING PRES(psi)	22
MOIST DENSITY(pcf)	103.72
% MOISTURE	45.69%
STRAIN RATE(%/min)	1.03

CARLSTADT PRP/FACILITY COORDINATOR
943-6222.0300

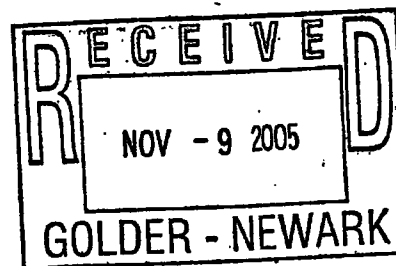
DATE	11/03/05
TECH	RMW
REVIEW	RMW

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

APPENDIX C

ASGEIC WETLANDS DELINEATION LETTER

November 7, 2005



Ms. Amy Dula
Golder Associates, Inc.
24 Commerce Street
Suite 430, 4th Floor
Newark, NJ 07102

RE: Task 1 - Wetland Jurisdictional Issues
Carlstadt SCP Site - Approximately 5 Acres
Carlstadt Boro, Bergen County, NJ
ASGECI Project 2425

Dear Ms. Dula:

AMY S. GREENE ENVIRONMENTAL CONSULTANTS, INC. (ASGECI) pleased to prepare this letter report discussing wetland jurisdiction issues for the proposed replacement of the existing bulkhead at the Carlstadt SCP Site. The SCP site is located within Carlstadt Borough in Bergen County and is within the regulatory boundaries of the NJ Meadowlands Commission (NJMC). The SCP site consists of an approximately 5 acre area covered with a thick plastic membrane. A slurry wall surrounds the site and wells are installed through the membrane to pump and treat groundwater. Route 120 (Paterson Plank Road) and Gotham Parkway abut the southwestern and northwestern site boundaries, respectively. A trucking company is located along the southeastern site boundary. Peach Island Creek runs along the northeastern site boundary. Peach Island Creek drains to Berry's Creek, which eventually discharges to the Hackensack River.

Based on our conversation regarding the area of activity and the field investigation performed on October 5, 2004, the proposed activities will be limited to inland of the bulkhead/mean high water line. The following is a brief description of the wetland/open water jurisdictional issues for the project:

Wetlands

As provided in the NJDEP Freshwater Wetlands Protection Act rules (N.J.A.C. 7:7A-2.9), freshwater wetlands, wetland transition areas and open waters located within the jurisdiction boundaries of the NJ Meadowlands are not regulated by the NJDEP and do not require a freshwater wetland, transition area waiver or open water fill permit. The USACOE has jurisdiction over fill activities in wetlands and open waters in the NJ Meadowlands under Section 404 of the Federal Clean Water Act. During the field investigation performed by ASGECI on October 5, 2004, no wetland or upland vegetation was identified along the creek. A drainage channel, lined with plastic, surrounds the site perimeter. Emergent wetland vegetation, including spike rush (*Eleocharis* spp.), rice cut grass (*Leersia oryzoides*), common cattail (*Typha* spp.) and a few common reed (*Phragmites australis*), are found in a few ponded areas within the plastic lined ditch. No additional vegetation was found onsite due to the plastic membrane. Although some hydrophytic vegetation occurs onsite, within drainageways around the site perimeter, it will not be regulated as a "jurisdictional wetland" by the USACOE since it has formed within water that pools on the plastic membrane. Therefore, there are no wetlands onsite that would be regulated by the USACOE. A

Ms. Amy Dula
ASGECI Project 2425
Page 2

wetland and open water delineation is not required to be performed within the project site. The only areas regulated by the USACOE are the tidal waters of Peach Island Creek.

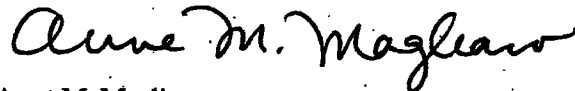
Since the bulkhead is proposed to be replaced landward of the existing bulkhead, and no filling activities are proposed in Peach Island Creek, **no approval from the USACE would be required for this project.** In addition, the NJDEP will not regulate wetlands, wetland transition areas or open waters under the Freshwater Wetlands Protection Act rules (N.J.A.C. 7:7A) since the project is located within the NJ Meadowlands.

It is recommended that a request for a Jurisdictional Determination (JD) be submitted to the United States Army Corps of Engineers (USACE) to confirm that no Section 404 permit is required. It is also recommended that a Jurisdictional Determination to determine the need for a Stream Encroachment Permit be submitted to NJDEP. The JD requests should include a site plan indicating that the proposed project will not disturb areas waterward of the bulkhead.

Do not hesitate to contact me at *extension 32* if you have any questions regarding this preliminary assessment.

Very truly yours,

AMY S. GREENE ENVIRONMENTAL
CONSULTANTS, INC.



Anne M. Magliaro
Project Manager

AMM/CWH/asg

APPENDIX D

100-YEAR AND 500-YEAR FLOOD ELEVATIONS

DESIGN MEMORANDUM
(Revised May 3, 2007 by Amy Dula)

To: Mark F. McNeilly, P.E.

From: Daniel Gorman

Cc: Bob Illes

Re: 100-year and 500-year Flood Elevations
216 Patterson Plank Road Site
Carlstadt, Bergen County, New Jersey

Attachments: Figure 1: Flood Insurance Rate Map (FIRM) with Site boundaries delineated

References: Flood Insurance Study (FIS), Bergen County, New Jersey, December 8, 1998

As requested, I obtained electronic copies of the Flood Insurance Study (FIS) and associated flood maps for the subject property. Said FIS and maps were prepared by the Federal Emergency Management Agency (FEMA).

For the subject property, the 100-yr and 500-yr flood elevations for two (2) survey nodes are as follows:

- Node 60 (see Figure 1)
 - 100-yr Elevation: 8.2-feet
 - 500-yr Elevation: 8.7-feet
- Node 61 (see Figure 1)
 - 100-yr Elevation: 8.3-feet
 - 500-yr Elevation: 8.7-feet

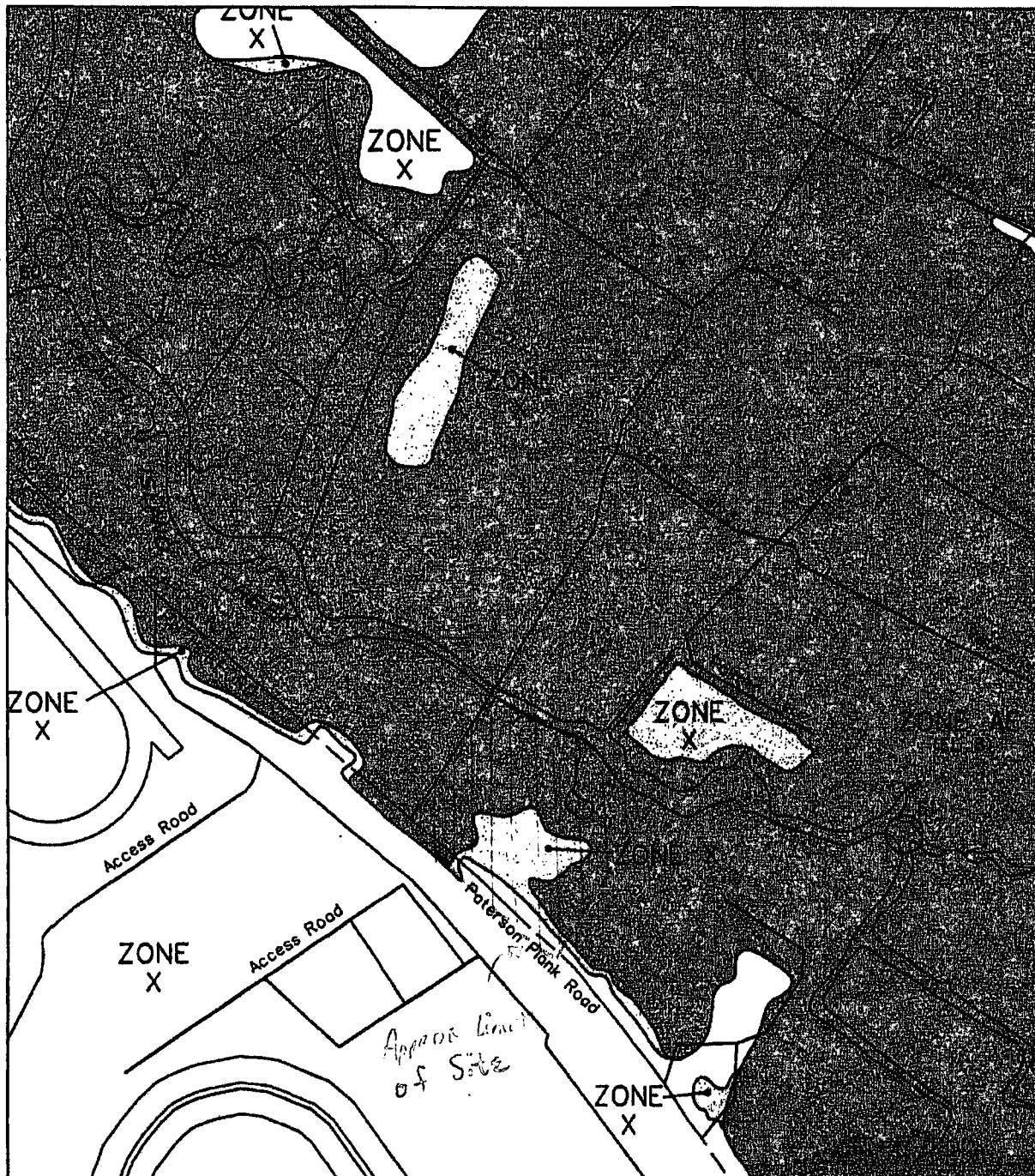
See attached for approximate limits of the subject property superimposed on the corresponding FEMA Flood Insurance Rate Map (FIRM) for the area of concern. Node 60 is at the confluence of Berry's and Peach Island Creeks, which is located 2,000 feet northwest of the Site (see Figure 1). Node 61 is located 750 feet east of the Site (see Figure 1).

As can be seen from Figure 1, a majority of the subject property resides within the 100-yr floodplain, and practically the entire site resides within the 500-yr floodplain.

Therefore, it is recommended that the following flood elevations be used for design purposes:

- 100-yr Floodplain: El. 8.3-feet
- 500-yr Floodplain: El. 8.7-feet

Elevations presented herein are with respect to the National Geodetic Vertical Datum of 1929 (NVGD 1929), or mean sea level, which is 1.10 feet above the North American Vertical Datum of 1988 (NAVD 1988).



APPROXIMATE SCALE
500 0 500 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
**BERGEN COUNTY,
NEW JERSEY
(ALL JURISDICTIONS)**

PANEL 254 OF 332

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CARLESTADT, BOROUGH OF	34002	0254	F
EAST RUTHERFORD, BOROUGH OF	34003	0254	F
INDENHURST MEADOWLANDS DISTRICT	34003	0254	F
ROCK-HOLE, BOROUGH OF	34003	0254	F

Please to Users: The MAP NUMBER shown below should be used when placing map orders. The COMMUNITY NUMBER shown above should be used on insurance applications for the subject community.

MAP NUMBER
34003C0254 F

EFFECTIVE DATE:
SEPTEMBER 20, 1995



Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT Version 1.0. This map does not reflect changes or amendments which may have been made subsequent to the data on the title block. Further information about National Flood Insurance Program flood hazard maps is available at www.fema.gov/mit/led.

Print Date: 8/1/2005 (printed at scale and type B)

Figure 1

APPENDIX E

CAP DESIGN CALCULATIONS

Golder Associates	SUBJECT: Infinite Veneer Stability Analysis		
	Job No.: 943-6222	Made by: VEF	Date: 10/26/06
	Ref.: Carlstadt	Checked: DKL	Sheet 1 of 6
		Reviewed: MFM	

OBJECTIVE: To evaluate the required minimum shear strength parameters to provide an acceptable factor-of-safety against veneer instability using infinite slope analysis and considering the proposed cap configuration and during construction.

METHOD: Methodology based on References Nos. 1, 2, and 3 to evaluate proposed Landfill cap on maximum 10% slopes. The veneer stability analysis considered the typically encountered case as follows:

Case 1: Drained Cover Soil with Construction Loads: Considers veneer stability of the proposed geosynthetic cap configuration with the addition of construction loading and without additional induced seepage forces resulting from a hydraulic head build-up upon the barrier layer. This case is representative of a geosynthetic cap designed using water balance methods with a geocomposite drainage layer that results in a 'no head' condition on steeper slopes.

Case 2: Drained Cover Soil with Construction Loads: Considers veneer stability of the proposed geosynthetic cap configuration with the addition of construction loading and without additional induced seepage forces resulting from a hydraulic head build-up upon the barrier layer. This case is representative of a geosynthetic cap designed using water balance methods with a geocomposite drainage layer that results in a 'no head' condition on steeper slopes.

Case 3: Undrained Cover Soil with Construction Loads: Considers veneer stability of the proposed geosynthetic cap configuration with the addition of construction loading and with additional induced seepage forces resulting from a hydraulic head build-up upon the barrier layer. A "head" of 6-inches is assumed.

The friction angle typically associated with the GCL/geomembrane interface of 25.3 degrees is provided. Based upon this information, the factor of safety was calculated for each scenario.

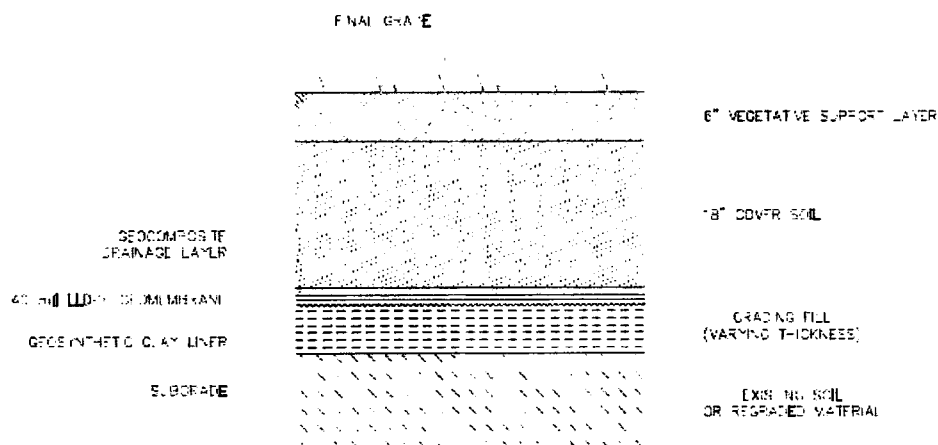
Golder Associates	SUBJECT: Infinite Veneer Stability Analysis		
	Job No.: 943-6222	Made by: VEF	Date: 10/26/06
	Ref.: Carlstadt	Checked: DKL	Sheet 2 of 6
		Reviewed: MFM	

REFERENCES:

1. "Stability of Lined Slopes at Landfills and Surface Impoundments," D. H. Mitchell, M. A. McLean and T. E. Gates, EPA 600/2-89/057.
2. "Final Covers for Solid Waste Landfills and Abandoned Dumps," R. Koerner and D. Daniel, 1997.
3. "Designing with Geosynthetics," 4th edition, R. Koerner, 1998.
4. "Soil-Mechanics in Engineering Practice," 2nd edition, K. Terzaghi and R.B. Peck, 1967.
5. "Geosynthetic Design Guidance for Hazardous Waste Landfill Cells and Surface Impoundments," R. Koerner and G. N. Richardson, 1987.
6. "Interfacial Friction Study of Cap and Liner Components for Landfill Design," M. M. Koutsourais, C. J. Sprague and R. C. Pucetas, Proceedings of the 4th GRI Seminar (December 1990).
7. Laboratory Testing by Golder Associates Inc.

ASSUMPTIONS:

1. Maximum cap slopes to be constructed will not exceed 10%
2. Proposed geosynthetic cap configuration is as follows:



3. Cover and bedding/cushion soils will be a predominately granular (zero cohesion), free-draining material with a moist unit weight of 110 pcf and saturated unit weight of 120 pcf.
4. Slopes length shall be sufficiently long to presume infinite analysis valid (i.e., cap thickness << slope length).
5. Geomembrane (GM) shall be a textured (both sides), very flexible/linear low-density polyethylene geomembrane.
6. As otherwise stated in the calculations.

Golder Associates	SUBJECT: Infinite Veneer Stability Analysis		
	Job No.: 943-6222	Made by: VEF	Date: 10/26/06
	Ref.: Carlstadt	Checked: DKL	Sheet 3 of 6
		Reviewed: MFM	

7. Pressure distribution area is assumed to occur at a 30° distribution angle and is calculated as shown below.

$$W_e = \frac{P}{2 * l * (w + (2 * \tan \alpha * T))}$$

CALCULATIONS: Attached.

DEFINITIONS:

- β = slope angle
- ϕ_{req} = minimum required interface friction angle
- γ_w = unit weight of water = 62.4 pcf
- γ_m = moist unit weight of cover soil
- γ_{sat} = saturated unit weight of cover soil
- γ_B = buoyant unit weight of cover soil = $\gamma_{sat} - \gamma_w$
- c_a = adhesion
- T = thickness of cover soil
- h = saturated thickness
- w = width of Equipment track
- l = length of Equipment track
- W = Weight of Equipment
- W_e = Weight of Equipment per unit area
- α = Angle of distribution

CONCLUSIONS: Based on the methodology and assumptions stated above and the specified shear strength parameters (represented by friction angle and cohesion/adhesion), the factors of safety for three scenarios were calculated and are shown in the table below.

Table 1 Minimum Required Shear Strength			
Factor of Safety	Friction Angle	Head (feet)	Cohesion/ Adhesion
2.17	25.3°	0	0
1.89	17.6°	0	50 psf
2.05	25.3°	0.5	0

Infinite Slope Stability Analysis Carlstadt Site

Case 1: Drained Cover Soil with Construction Loading

Moist Unit Weight of Soil (γ):	110 pcf	$FS = \frac{[\gamma_d(T-d) + (\gamma_{sat} - \gamma_w)d + W_e] \cos \beta \tan \phi + c_a}{[\gamma_d(T-d) + (\gamma_{sat})d + W_e] \sin \beta + W_e \alpha}$
Saturated Unit Weight of Soil (γ_{sat}):	120 pcf	
Thickness of Soil (T):	2 feet	
Slope Angle (β):	5.71 degrees	
Unit Weight of Water (γ_w):	62.4 pcf	
Depth of Water (d):	0 feet	
Critical Friction Angle (ϕ_{crit}):	17.6 degrees	
Adhesion (c_a):	50 psf	
Weight of the Equipment:	32890 lb	
Track Length	10.25 ft	
Track Width	2.8 ft	$FS = 1.89$
Weight per Unit Area (W_e):	314 psf	
Description fo Equipment:	CAT D6M LGP	
Acceleration Force (α)	0.2 g	
Load Distribution	30 degrees	

Infinite Slope Stability Analysis Carlstadt Site

Case 2: Drained Cover Soil with Construction Loading

Moist Unit Weight of Soil (γ):	110 pcf	$FS = \frac{[\gamma_d(T-d) + (\gamma_{sat} - \gamma_w)d + W_a] \cos \beta \tan \phi + c_a}{[\gamma_d(T-d) + (\gamma_{sat} - \gamma_w)d + W_a] \sin \beta + W_a \alpha}$
Saturated Unit Weight of Soil (γ_{sat}):	120 pcf	
Thickness of Soil (T):	2 feet	
Slope Angle (β):	5.71 degrees	
Unit Weight of Water (γ_w):	62.4 pcf	
Depth of Water (d):	0 feet	
Critical Friction Angle (ϕ_{crit}):	25.3 degrees	
Adhesion (c_a):	0 psf	
Weight of the Equipment:	32890 lb	
Track Length	10.25 ft	
Track Width	2.8 ft	$FS = 2.17$
Weight per Unit Area (W_a):	314 psf	
Description of Equipment:	CAT D6M LGP	
Acceleration Force (α):	0.2 g	
Load Distribution	30 degrees	

Infinite Slope Stability Analysis Carlstadt Site

Case 3: Undrained Cover Soil with Construction Loading

Moist Unit Weight of Soil (γ):	110 pcf	$FS = \frac{[\gamma(T-d) + (\gamma_{sat} - \gamma_w)d + W_e] \cos \beta \tan \phi + c_n}{[\gamma(T-d) + (\gamma_{sat} - \gamma_w)d + W_e] \sin \beta + W_e \alpha}$
Saturated Unit Weight of Soil (γ_{sat}):	120 pcf	
Thickness of Soil (T):	2 feet	
Slope Angle (β):	5.71 degrees	
Unit Weight of Water (γ_w):	62.4 pcf	
Depth of Water (d):	0.5 feet	
Critical Friction Angle (ϕ_c):	25.3 degrees	
Adhesion (c):	0 psf	
Weight of the Equipment:	32890 lb	
Track Length	10.25 ft	
Track Width	2.8 ft	$FS = 2.05$
Weight per Unit Area (W_e):	314 psf	
Description of Equipment:	CAT D6M LGP	
Acceleration Force (α):	0.2 g	
Load Distribution	30 degrees	

SUBJECT Infinite Veneer Stability Analysis

Job No. 943-6272
Ref.

Made by DKL

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Objective: To evaluate the required minimum shear strength parameters to provide an acceptable factor-of-safety against veneer instability using infinite slope analysis and considering the proposed Alternate cap configuration and saturated situation.

Methods:

To evaluate proposed landfill cap on maximum 10% slopes. The veneer stability analysis considered a scenario as follows:

Case 4: Saturated Cover Soil without Construction Loads: Consider veneer stability of the proposed geosynthetic cap configuration after the construction being completed and with additional induced seepage forces resulting from a hydraulic head build-up upon the barrier layer. The cover soil is assumed to be saturated and the "head" is 2-feet.

The friction angle typically associated with the GCL/geomembrane interface of 25-30 degrees is provided. Based upon this information, the factor of safety was calculated.

References:

1. Golder Associates Inc., 2005. Preliminary (35% Design) Design Report Operable Unit 2 (OU-2), December 2005.
2. Zornberg, J.G. Geosynthetic Reinforcement in Landfill Design: U.S. Perspectives. GSP 141 International Perspectives on Reinforcement Applications.
3. Zornberg, J.G., Somasundaram, S., and LaFountain, L. Design of Geosynthetic Reinforced Veneer Slopes.

Assumptions:

1. Maximum cap slopes to be constructed will not exceed 10%.
2. Proposed geosynthetic cap configuration is as follows:

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SUBJECT

Job No. 963-6221
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Made by DCL

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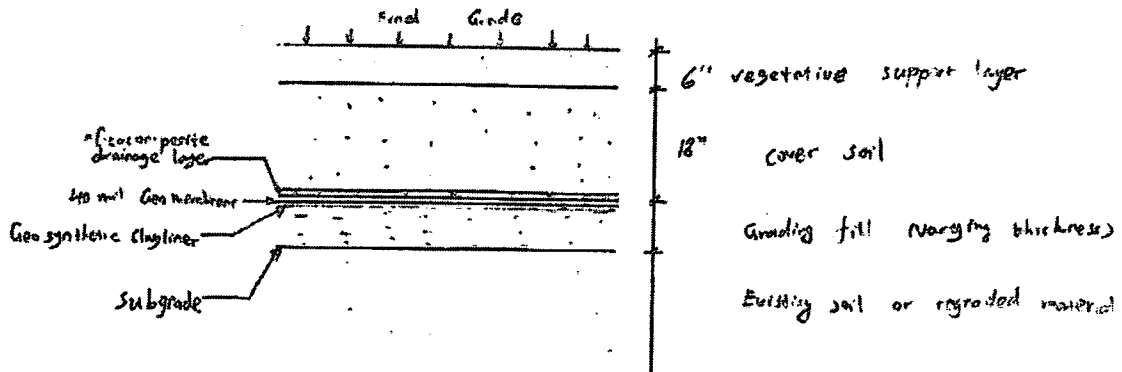
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- Cover and bedding/cushion soils will be a predominately granular (zero cohesion), free draining material with a moist unit weight of 110 pcf and saturated unit weight of 120 pcf
- Slopes length shall be sufficiently long to presume infinite analysis valid (i.e., cap thickness \ll slope length)
- Geomembrane (GM) shall be a textured (both sides), very flexible/linear low-density polyethylene geomembrane.

Calculations: Attached.

Definitions:

β = slope angle

ϕ_{req} = minimum required interface friction angle

γ_w = unit weight of water = 62.4 pcf

γ_m = moist unit weight of cover soil

γ_{sat} = saturated unit weight of cover soil

γ_b = buoyant unit weight of cover soil = $\gamma_{sat} - \gamma_w$

c_0 = adhesion

T = thickness of cover soil

h = saturated thickness

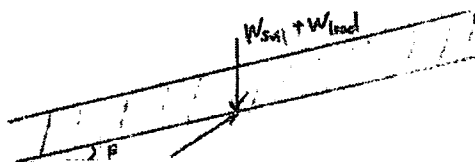
w = width of Equipment track

l = length of Equipment track

W = Weight of Equipment

W_e = Weight of Equipment per unit area

α = Angle of load distribution



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Conclusions: Based on the methodology and assumptions stated above and the specified shear strength parameters (represented by friction angle and cohesion/adhesion), the factor of safety for Case 4 was calculated and is shown as below.

Factor of Safety
2.27

Friction Angle
25.3°

Head (feet)
2

Cohesion
0

Case 4: Saturated Cover Soil without Construction Loading

Moist Unit Weight of Soil (γ_t):	110	pcf
Saturated Unit Weight of Soil (γ_{sat}):	120	pcf
Thickness of Soil (T):	2	feet
Slope Angle (β):	5.71	degrees
Unit Weight of Soil (γ_w):	62.4	pcf
Depth of Water (d):	2	feet
Critical Friction Angle (ϕ_{req}):	25.3	degrees
Adhesion (c_a):	0	psf
Weight of the Equipment:	32890	lb
Track Length:	10.25	feet
Track Width:	2.8	feet
Weight per Unit Area (W_e):	0	psf
Description of Equipment:	CAT D6M LGP	
Acceleration Force (α):	0.2	g
Load Distribution:	30	degrees

$$FS = \frac{[\gamma_t(T-d) + (\gamma_{sat} - \gamma_w)d + W_e] \cos \beta \tan \phi + c_a}{[\gamma_t(T-d) + (\gamma_{sat})d + W_e] \sin \beta + W_e \alpha}$$

$$FS = 2.27$$

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SUBJECT Maximum and Minimum Total Settlement Analysis		
Job No. 943-6222	Made by WED	Date
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OBJECTIVE:

ESTIMATE THE RANGE OF TOTAL SETTLEMENT (PRIMARY AND SECONDARY) AT 50 YEARS FOR A DESIGN PROFILE. THE TOTAL SETTLEMENT RANGE IS BASED ON THE MAXIMUM AND MINIMUM THICKNESS OF EACH STRATIFIED LAYER, WITH THE ADDITION OF A SURCHARGE LOAD THAT REPRESENTS THE FILL AND CAP THAT WILL BE USED IN THE FINAL DESIGN SOLUTION.

Determination of Maximum Primary Settlement

FOR THIS ANALYSIS THE DESIGN PROFILE WILL BE ADJUSTED AS FOLLOWS TO OBTAIN THE ESTIMATED MAXIMUM AND MINIMUM TOTAL SETTLEMENT (S_T)

<u>LAYER</u>	<u>LAYER THICKNESS</u>	
	<u>Maximum S_T</u>	<u>Minimum S_T</u>
SURCHARGE	6'	6'
FILL	5'	3'
PEAT	6'	0'
ORGANIC SILTY CLAY	3'	2'
UPPER VARIED CLAY	20'	20'
LOWER VARIED CLAY	20'	20'
GLACIAL TILL	20'	20'

SETTLEMENT RESULTING FROM 1-DIMENSIONAL COMPRESSION CAN BE ESTIMATED AS FOLLOWS:

$$S_T = S_p + S_s$$

WHERE S_T IS THE TOTAL SETTLEMENT, S_p IS THE PRIMARY SETTLEMENT AND S_s IS THE SECONDARY SETTLEMENT. PRIMARY SETTLEMENT IS ESTIMATED BY THE SUM OF THE COMPRESSION

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SUBJECT Aluminum and Manganese Tank Settlement Analysis			
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SETTLEMENT (S_c) AND THE RECOMPRESSION SETTLEMENT (S_r) AS REPRESENTED BY THE FOLLOWING EQUATION:

$$S_p = S_c + S_r$$

COMPRESSION SETTLEMENT IS ULTIMATELY SOLVED WITH THE EQUATION:

$$S_c = \frac{C_c}{1 + e_0} L_0 \log \left(\frac{\sigma'_{vg}}{\sigma'_p} \right)$$

WHERE:

C_c = COMPRESSION INDEX
 e_0 = INITIAL VOID RATIO
 L_0 = INITIAL LAYER THICKNESS
 σ'_{vg} = FINAL EFFECTIVE STRESS
 σ'_p = PRECONSOLIDATION PRESSURE

LIKEWISE, RECOMPRESSION SETTLEMENT RELATIONSHIP IS DESCRIBED AS FOLLOWS:

$$S_r = \frac{C_r}{1 + e_0} L_0 \log \left(\frac{\sigma'_{vg}}{\sigma'_{v0}} \right)$$

WHERE:
 C_r = RECOMPRESSION INDEX
 σ'_{v0} = INITIAL EFFECTIVE STRESS

FURTHER, THE TIME DEPENDENT NATURE OF SECONDARY SETTLEMENT CAN BE CONSIDERED WITH THE EQUATION BELOW:

$$S_c = \frac{C_{\alpha}}{1 + e_0} L_0 \log \left(\frac{t}{t_p} \right)$$

IN WHICH:

C_{α} = SECONDARY
 t = TIME
 t_p = TIME OF END OF PRIMARY CONSOLIDATION (EOP)

USING THE EQUATIONS PROVIDED ABOVE, THE DESIGN PROFILE WITH THE DESIGNATED MAXIMUM THICKNESSES AND THE DESIGN PARAMETERS GIVEN IN TABLE 1, VERTICAL STRESSES ARE CALCULATED AS FOLLOWS:

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	LAYER	SUBLAYER	h_i	D_i	σ_{v0}	σ_w	σ'_{v0}	OCR	σ'_p
①	Fill	a) DRY	3	1.5	180	0	180	1.5	270
②	Fill	b) WET	2	40	480	280	230	1.5	346
③	PEAT		6	80	640	499	141	1.0	200
④	ORGANIC SILT CLAY		3	125	1375	780	595	1.5	900
⑤	UPPER VARIED CLAY		20	24	2880	1498	1382	2.0	4000
⑥	LOWER VARIED CLAY		20	44	5060	2746	2314	2.0	4629
⑦	GRAVEL TILL		20	64	7680	3994	3686	6.0	22118

WHERE:

h_i = LAYER THICKNESS

D_i = MID POINT DEPTH OF LAYER

σ_{v0} = $\gamma_s \cdot D_i$

σ_w = $\gamma_{water} \cdot D_i$

σ'_{v0} = $\sigma_{v0} - \sigma_w$

σ'_p = $OCR \cdot \sigma'_{v0}$ IF $> p_c$ OTHERWISE $\sigma'_p = p_c$

Table 1 - Preliminary Geotechnical Design Parameters

Material/Strata	Index Properties			Consolidation Parameters											Strength Parameters		
	γ_{sat}	w_o	PI	e_o	OCR	P_c	Compression Indices			Compression Ratios				C_v	f	c	S_u
							C_c	C_r	C_α	C_c/C_c	$C_r/(1+e_o)$	$C_\alpha/(1+e_o)$	$C_\alpha/(1+e_o)$				
Imported Fill Materials:																	
Common, Grading Fill	120				1.0										33	0	
Structural Fill	120				1.0										33	0	
Subsurface Deposits:																	
Fill	120			0.7	1.5	200	0.15	0.01	0.00	0.02	0.088	0.006	0.002	0.40	33	0	
Meadow Mat/Peat	80	300		9.0	1.0	200	6.00	0.50	0.36	0.06	0.600	0.050	0.036	1.00	0		100
Organic Silt/Clay	110	120	40	2.0	1.5	900	0.90	0.01	0.05	0.05	0.300	0.003	0.015	0.20	0		200
Upper Varved Clay	120	30	20	0.8	2.0	4000	0.40	0.03	0.02	0.04	0.222	0.017	0.009	0.20	0		600
Lower Varved Clay	115	50	30	1.1	2.0	2500	0.60	0.03	0.02	0.04	0.286	0.014	0.011	0.30	0		400
Glacial Till	120	10	5	0.6	6.0	8000	0.16	0.01	0.01	0.04	0.100	0.006	0.004	0.35	28	200	

Legend:

γ_{sat} = Unit Weight, lbs/ft³ (pcf)

w_o = Natural Water Content, %

PI = Plasticity Index

e_o = Initial Void Ratio

OCR = Preconsolidation Pressure

P_c = Initial Void Ratio

C_c = Compressibility Index

C_r = Recompression Index

C_α = Secondary Compression Index

C_v = Coefficient of Consolidation, ft²/day

f = Internal Friction Angle, degrees

c = Cohesion, lbs/ft² (pcf)

S_u = Existing Mobilized Undrained Shear Strength, lbs/ft² (pcf)

Notes:

a) Design values shown herein are based on laboratory testing data, published literature, experiences with similar materials, generally accepted industry standards, and professional geotechnical engineering judgment.

b) C_α and C_v values vary with load, and values shown herein typically correspond to a load increment of 2 tsf.

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SUBJECT MAXIMUM AND MINIMUM TOTAL SETTLEMENT ANALYSIS

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EFFECTIVE STRESSES INCORPORATING THE SURCHARGE LOAD ARE CALCULATED USING THE DESIGN PARAMETERS AND THICKNESS AS REPRESENTED BY $\Delta \sigma'_v$ WHERE:

$$\Delta \sigma'_v = \gamma_{\text{SURCHARGE}} \cdot H_{\text{SURCHARGE}}$$

TO ACCOUNT FOR STRESS REDUCTION WITH INCREASED DEPTH, A 2:1 (V:H) DISTRIBUTION WAS INCORPORATED ASSUMING A G' SURCHARGE LAYER THICKNESS ($H_{\text{SURCHARGE}}$) AND A 500' SURCHARGE LENGTH ($L_{\text{SURCHARGE}}$) SUCH THAT:

$$\Delta \sigma'_{vi} = \frac{(\gamma_{\text{SURCHARGE}} \cdot H_{\text{SURCHARGE}} \cdot L_{\text{SURCHARGE}})}{(L_{\text{SURCHARGE}} + h_i)}$$

THE FINAL EFFECTIVE STRESS IS A SUM OF THE INITIAL AND SURCHARGE EFFECTIVE STRESSES AS DESCRIBED BY THE FOLLOWING EQUATION:

$$\sigma'_{vf} = \sigma'_{vo} + \Delta \sigma'_{vi}$$

THE COMPUTED FINAL EFFECTIVE STRESS AND PRIMARY SETTLEMENTS ARE AS FOLLOWS:

LAYER	$\Delta \sigma'_{vi}$	σ'_{vf}	$\frac{C_u}{1+e_0}$	$\frac{e_r}{1+e_0}$	S_c	S_r
① Fill - DRY	718	898	0.098	0.006	0.138	0.003
② Fill - WET	714	945	0.098	0.006	0.524	0.002
③ PRET	709	849	0.400	0.050	1.131	0.046
④ ORGANIC SILT CLAY	702	1247	0.300	0.003	0.106	0.002
⑤ UPPER VARIED CLAY	687	2069	0.222	0.017	0.000	0.000
⑥ LOWER VARIED CLAY	662	2976	0.286	0.014	0.000	0.000
⑦ GRAVEL TILL	638	4325	0.100	0.006	0.000	0.000

SUB TOTAL 1.899 0.053 ft

$$S_T = S_C + S_r = 1.899 + 0.053 = \underline{\underline{1.952 \text{ ft}}}$$

ESTIMATED TIME OF PRIMARY SETTLEMENT

THE TIME OF PRIMARY SETTLEMENT CAN BE DETERMINED BY DETERMINING THE RELATIONSHIP BETWEEN THE DEGREE OF CONSOLIDATION AND ITS TIME FACTOR (T_v) AS SHOWN HERE:

$$T_v = \frac{C_v t}{H_{\text{DRAINAGE}}^2}$$

WHERE C_v IS THE COEFFICIENT OF COMPRESSIBILITY, H IS THE MAXIMUM DRAINAGE DISTANCE IN THE SUBSURFACE PROFILE AND t IS THE TIME OF CONSOLIDATION THAT APPROXIMATES THE TIME OF PRIMARY SETTLEMENT.

ASSUMING A TWO-WAY DRAINED PROFILE, T_v CAN BE ESTIMATED WITH THESE EQUATIONS DEVELOPED BY CASAGRANDE (1938) AND TAYLOR (1948):

FOR $U < 60\%$ $T_v = \frac{\pi}{4} U^2$ AND

FOR $U > 60\%$ $T_v = 1.781 - 0.933 \log(100 - U)$

THE RESULTING T_v VALUES CORRESPONDING TO THE DEGREE OF CONSOLIDATION ARE AS FOLLOWS:

<u>U</u>	<u>T_v</u>
0%	0
5%	0.002
10%	0.008
20%	0.031
30%	0.071
40%	0.126
50%	0.196
60%	0.286
70%	0.403
80%	0.567
90%	0.848
95%	1.129
99%	1.781

THE MAXIMUM DRAINAGE DISTANCE (H_{DRAINAGE}) FOR THE DESIGN PROFILE IS ASSUMED TO BE FROM THE GROUND SURFACE TO THE MID DEPTH OF THE GLACIAL TILL LAYER.

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$$\therefore H_{\text{DRAINAGE}} = \frac{1}{2} (3+2+6+3+20+20+20/2) = 32 \text{ ft}$$

SINCE C_v VARIES AMONG THE LAYERS IN THE DESIGN PROFILE, A HARMONIC MEAN IS CALCULATED AND USED FOR DETERMINING THE PRIMARY SETTLEMENT TIME, ASSUMING THE GLACIAL TILL C_v IS EQUAL TO THE HARMONIC MEAN OF THE OVERLYING LAYERS THE HARMONIC MEAN C_v IS CALCULATED AS FOLLOWS

$$C_v = (3+2+6+3+20+20) \cdot (3/4 + 2/4 + 6/1 + 3/2 + 20/2 + 20/2)^{-1}$$

$$= 0.2698 \text{ ft}^2/\text{DAY}$$

USING THE CALCULATED T_v , H_{DRAINAGE} AND C_v PARAMETERS, THE CONSOLIDATION RESULTS ARE AS FOLLOWS:

<u>U</u>	<u>t</u>	
5%	0.02	YR
10%	0.03	YR
20%	0.32	YR
30%	0.72	YR
40%	1.28	YR
50%	2.01	YR
60%	2.93	YR
70%	4.12	YR
80%	5.80	YR
90%	8.67	YR
95%	11.51	YR
99%	18.21	YR = t_p

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ESTIMATE OF MAXIMUM SECONDARY SETTLEMENT

AS PREVIOUSLY STATED, SECONDARY SETTLEMENT IS CALCULATED USING:

$$S_s = \frac{C_\alpha}{1+e_0} L_0 \log\left(\frac{t}{t_p}\right)$$

WITH THE FOLLOWING RESULTS:

LAYER	$\frac{C_\alpha}{1+e_0}$	h_i	1821	20	30	50	100
FILL - DRY	0.002	3	0.0	0.0	0.001	0.002	0.004
FILL - WET	0.002	2	0.0	0.0	0.001	0.002	0.003
PEAT	0.036	6	0.0	0.0	0.002	0.005	0.008
ORGANIC SILT/ CLAY	0.015	3	0.0	0.0	0.001	0.002	0.004
UPPER VARVED CLAY	0.009	20	0.0	0.001	0.007	0.015	0.026
LOWER VARVED CLAY	0.011	20	0.0	0.001	0.007	0.015	0.026
GLACIAL TILL	0.004	20	0.0	0.001	0.007	0.015	0.024
SUB TOTALS			0.0	0.003	0.026	0.056	0.097 FT

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TOTAL MAXIMUM SETTLEMENT ESTIMATE

THE SETTLEMENTS AT 50 YRS FOR THE DESIGN PROFILE ARE SHOWN BELOW

LAYER	S_c	S_r	S_s 50YR	S_t 50YR
FILL-DRY	0.138	0.003	0.002	0.143
FILL-WET	0.524	0.002	0.002	0.528
PEAT	1.131	0.046	0.003	1.182
ORGANIC SILT/CLAY	0.106	0.002	0.002	0.110
UPPER VARVED CLAY	0.000	0.000	0.015	0.015
LOWER VARVED CLAY	0.000	0.000	0.015	0.015
GLACIAL TILL	0.000	0.000	0.015	0.015
				<u>2.008 ft</u>
				OR
				<u>24.1 in</u>

THESE CALCULATIONS SHOW THAT APPROXIMATELY 100% OF THE PRIMARY CONSOLIDATION WILL OCCUR WITHIN 18.2 YEARS RESULTING IN AN ESTIMATED SETTLEMENT OF 1.952 FT. BEYOND THIS TIME SECONDARY SETTLEMENT WILL DOMINATE AND RESULT IN AN ADDITIONAL 0.056 FT SETTLEMENT FOR A TOTAL SETTLEMENT OF 2.008 FT OVER 50 YEARS.

SEE ATTACHED SHEETS FOR MORE DETAIL OF THE SETTLEMENT.

TOTAL MINIMUM SETTLEMENT ESTIMATE

THE TOTAL MINIMUM SETTLEMENT ESTIMATE IS CALCULATED USING THE MINIMUM LAYER THICKNESS OF SUBSURFACE W.I.T. THESE THICKNESSES WERE PROVIDED IN THE "DETERMINATION OF MAXIMUM PRIMARY SETTLEMENT" SECTION.

SIMILAR PROCEDURES WERE USED IN FINDING THE MINIMUM SETTLEMENT AS USED WITH THE MAXIMUM SETTLEMENT CALCULATIONS. THEREFORE THE MINIMUM SETTLEMENT CALCULATIONS WERE INCORPORATED IN AN EXCEL SPREAD SHEET AND THIS RESULTS ARE ATTACHED.

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THE CALCULATED RESULTS FOR THE MINIMUM SETTLEMENT INDICATE THAT THE PRIMARY CONSOLIDATION WILL RESULT IN APPROXIMATELY 0.341 FT OF SETTLEMENT COMPLETE AFTER 15 YEARS. AT THIS POINT, SECONDARY SETTLEMENT WILL DOMINATE AND RESULT IN APPROXIMATELY 0.058 FT OF ADDITIONAL SETTLEMENT, TO BRING THE TOTAL SETTLEMENT TO 0.399 FT AT 50 YEARS.

GOLDER ASSOCIATES	Subject:	PERIMETER CHANNEL DESIGN - 95%		
	Job No:	943-6222	Made by:	VEF
	Ref:	Carlstadt	Check by:	MFM
			Review by:	
	Date:	10/25/06		
	Sheet:	1 of 15		

OBJECTIVE: To determine the channel depths necessary to convey all stormwater flow from the new vegetated cap at the Carlstadt site.

REFERENCES:

- 1) Figure entitled, "Grading and Surface Water Management Plan," prepared by Golder Associates, dated 10/20/06.
- 2) USDA, Soil Conservation Service, "Technical Release No. 55: Urban Hydrology for Small Watersheds" (TR-55), June, 1986.

METHOD:

Based upon the peak runoff value obtained in the following calculations, use a spreadsheet which implements Manning's equation for open channel flow (i.e. $Q = [1.49 / n] S^{1/2} R^{2/3} A$) to determine the required flow depths for the given geometry of the channels.

CALCULATIONS:

The calculations involved a two-step process, wherein the peak flow entering the channel was calculated and the design of the channel was evaluated.

Peak Flow Calculation

The TR-55 computer program was used to determine the peak runoff for each drainage area. This program requires several input parameter such as:

- Rainfall Type - Type III (see sheet 4 of 15);
- Design Storm - 25-year, 24-hour storm (6.25 inches) (see sheet 5 of 15);
- Drainage Area (as described below);
- Curve Number (as described below); and
- Time of Concentration (as described below).

Drainage Area

The site was divided into three drainage areas, as follows:

- One draining to the eastern perimeter channel (Drainage Area A);
- One draining to the western perimeter channel (Drainage Area B); and,
- One draining toward the Creek (Drainage Area C).

These areas were determined through the use of AutoCAD (see sheet 6 of 15) as:

Drainage Area	Area (s.f.)	Area (acres)
A	93,225	2.14
B	56,493	1.30
C	109,329	2.51

GOLDER ASSOCIATES	Subject:	PERIMETER CHANNEL DESIGN - 95%		
	Job No:	943-6222	Made by:	VEF
	Ref:	Carlstadt	Check by:	MCJ
			Review by:	
			Date:	10/25/06
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Curve Number

The Curve Number of 79 was used for the closed, vegetated condition, conservatively assuming hydrologic soil type C (from Table 2-2a - open space, fair condition) (see Sheet 7 of 15). This will provide conservative higher flow rates than anticipated from the expected good stand of vegetation at the Site.

Time of Concentration

The time of concentration (T_c), the length of time for runoff to travel from the most hydrology distant point within a drainage area, was determined for the drainage area, using methods outlined in Reference 2 (see sheet 6 of 15 for location). The time of concentration for each drainage area (see sheet 8 of 15 for calculation) is summarized below:

Drainage Area	T_c (hrs)
A	0.343
B	0.280
C	0.432

Peak Runoff

The peak runoff for stormwater from each drainage area was computed using the TR-55 software (see sheet 9 through 14 of 15), as summarized below:

Drainage Area	Perimeter Channel	Q (cfs)
A	Eastern	6
B	Western	4
C	Sheet Pile Wall	7

Channel Design Evaluation

Based on the calculated maximum peak flow of stormwater runoff, the design of the perimeter channels were determined. In determining the overall depths of the perimeter channels, the Manning's Equation for open channel flow was utilized. An Excel spreadsheet (see Sheet 15 of 15) was used to vary channel depths to determine the most appropriate channel depth for the corresponding channel lining. The Manning's Equation is as follows:

$$Q = (1.49 \times R_h^{2/3} \times A \times S^{1/2}) / n$$

Q = channel flow rate (cfs)

R_h = hydraulic radius of channel = A/P (ft)

A = cross-sectional area of flow (ft^2)

P = wetted perimeter of flow (ft)

S = channel slope (ft/ft)

n = Manning's coefficient

**GOLDER
ASSOCIATES**

Subject: PERIMETER CHANNEL DESIGN - 95%
Job No: 943-6222 Made by: VEF Date: 10/25/06
Ref: Carlstadt Check by: Review by: Sheet: 3 of 15

Hydraulic Radius, Cross Sectional Area, and Wetted Perimeter

Hydraulic radius, cross sectional area, and wetted perimeter of flow are dependent on the channel dimension and depth of flow. These parameters are determined by the shape of the channel, channel side slopes, and flow depth.

Channel Slope

The slope for each perimeter channel was estimated as 0.8%. Check for localized minimum and maximum slopes of 0.5% and 1.5%, respectively.

Manning's Coefficient

The Manning's coefficient ("n") is a resistance factor related to surface roughness, channel irregularity, obstructions in the channel, and channel alignment. It is assumed that the side slopes of the channel are grass lined and the bottom is gravel lined. Using this combination of linings, Manning's coefficient of 0.033 was used.

CONCLUSION:

The proposed perimeter channel will have a 3-foot base with, 2H:1V sideslopes, and a final depth of 1.2 feet, which provides a minimum of 0.5 feet of freeboard.

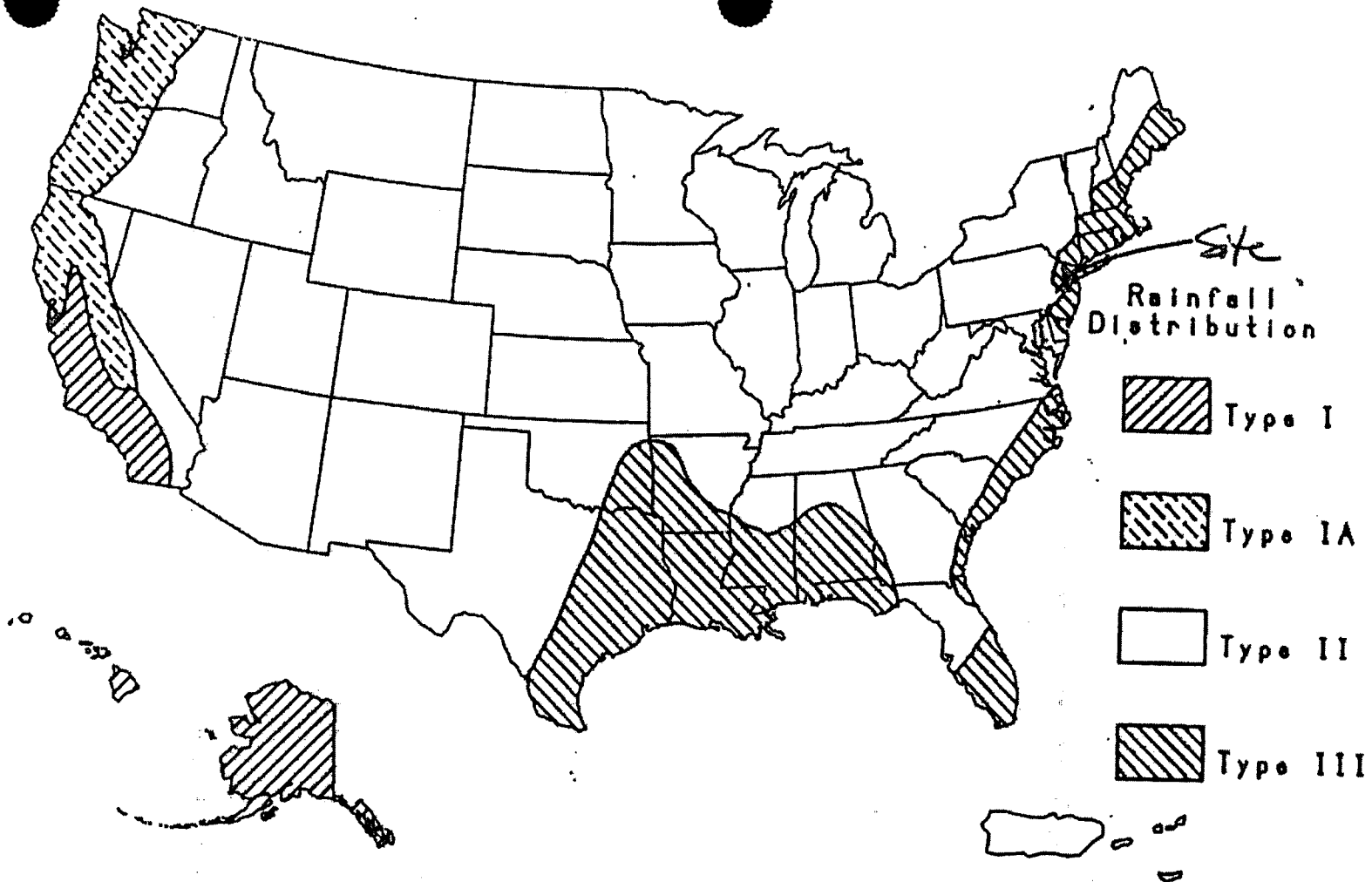


Figure 11-2.—Approximate geographic boundaries for SCS rainfall distributions.



POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14



New Jersey 40.848 N 74.092 W 111 feet
from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 2, Version 2 (draft)
G.M. Bormin, D. Todd, B. Lin, T. Parzybok, M. Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2004
Extracted: Thu Nov 3 2005

Confidence Limits

Seasonality

Location Maps

Other Info

GIS data

Maps

Help

D

ARI*

(years)

5 min

10 min

15 min

30 min

60 min

120 min

3 hr

6 hr

12 hr

24 hr

48 hr

4 day

7 day

10 day

20 day

30 day

45 day

60 day

2

0.40

0.63

0.79

1.08

1.35

1.67

1.86

2.40

2.95

3.32

3.90

4.31

5.04

5.73

7.68

9.54

12.09

14.44

5

0.47

0.75

0.94

1.33

1.70

2.11

2.35

3.02

3.74

4.25

4.98

5.47

6.28

7.02

9.17

11.17

13.96

16.51

10

0.52

0.83

1.05

1.51

1.95

2.45

2.74

3.53

4.39

5.05

5.89

6.42

7.29

8.09

10.34

12.41

15.37

18.05

25

0.59

0.94

1.18

1.73

2.30

2.93

3.28

4.24

5.34

6.25

7.23

7.81

8.75

9.60

11.93

14.02

17.20

20.00

50

0.64

1.01

1.27

1.90

2.56

3.32

3.73

4.84

6.16

7.29

8.37

8.96

9.97

10.84

13.17

15.25

18.55

21.42

100

0.69

1.08

1.36

2.07

2.83

3.72

4.18

5.47

7.02

8.44

9.61

10.21

11.27

12.15

14.43

16.46

19.87

22.75

200

0.73

1.15

1.45

2.23

3.10

4.14

4.67

6.14

7.97

9.71

10.98

11.56

12.66

13.53

15.69

17.64

21.14

24.00

500

0.79

1.23

1.55

2.43

3.47

4.73

5.34

7.10

9.36

11.64

13.00

13.51

14.64

15.49

17.39

19.15

22.74

25.52

1000

0.83

1.29

1.62

2.58

3.75

5.19

5.87

7.89

10.53

13.31

14.71

15.13

16.27

17.07

18.71

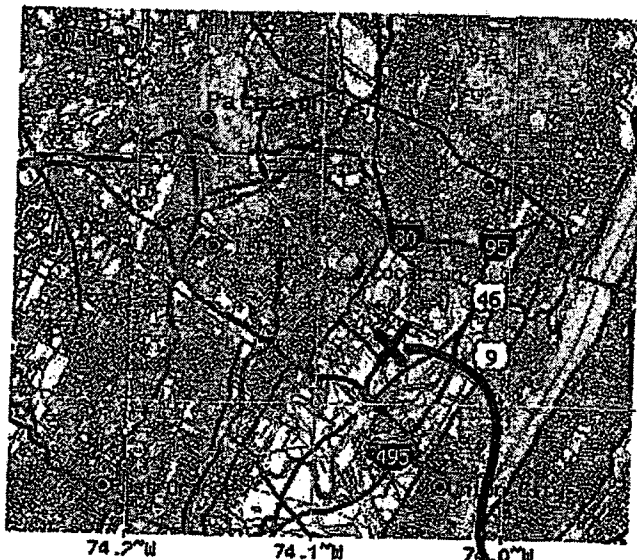
20.27

23.90

26.59

Text version of table

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval. Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.



These maps were produced using a direct map request from the
U.S. Census Bureau Mapping and Cartographic Resources
Tiger Map Server.

Please read [disclaimer](#) for more information.

LEGEND

- State
- County
- Indian Resv
- Lake/Pond/Ocean
- Street
- Expressway
- Highway
- Connector
- Stream
- Military Area
- National Park
- Other Park
- City
- County

Scale 1:228583
Average—true scale depends on monitor resolution

LEGEND

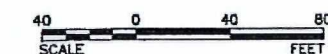
- EXISTING GROUND CONTOURS
- EDGE OF STREAM
- EXISTING FENCE
- PROPERTY LINE
- EXISTING SHEET PILE WALL (TO BE PARTIALLY REMOVED)
- NEW SHEET PILE WALL
- WEIR (SEE NOTE 5)
- SPOT ELEVATION
- LIMITS OF NEW GEOMEMBRANE
- PROPOSED GROUND CONTOURS
- SILT FENCE, SEE DETAIL (3/7)
- TEMPORARY STABILIZED CONSTRUCTION ENTRANCE, SEE DETAIL (3/7)
- PERIMETER DRAINAGE CHANNEL (SEE DETAILS (2/5) AND (4/5))
- NEW PERIMETER ACCESS ROAD AND PARKING AREAS (SEE DETAILS (3/5) AND (5/5))

NOTES

- ALL LOCATIONS ARE APPROXIMATE.
- TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES AND LOCATIONS SHOWN HEREIN ARE GENERAL MEASURES TO BE INSTALLED DURING CONSTRUCTION. EXACT LOCATIONS, SIZES, AND TYPES OF TEMPORARY MEASURES WILL BE SELECTED BY THE CONTRACTOR BASED UPON ITS CONSTRUCTION SEQUENCING.
- CONTRACTOR SHALL BE REQUIRED TO SUBMIT TO THE REMEDIAL DESIGNER AND/OR GROUP'S REPRESENTATIVE FOR FAVORABLE REVIEW AN EROSION AND SEDIMENT CONTROL PLAN, SHOWING THEIR CONSTRUCTION SEQUENCING AND PROPOSED TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES TO BE IMPLEMENTED.
- TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES SHALL BE CONSTRUCTED AND MAINTAINED IN COMPLIANCE WITH THE RECOMMENDATIONS INCLUDED IN THE "STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY."
- SURFACE WATER FLOWS SHALL BE CONVEYED TO PEACH ISLAND CREEK VIA THE PERIMETER DRAINAGE CHANNELS, AND DISCHARGE TO CREEK THROUGH A SERIES OF WEIRS IN THE TOPS OF THE SHEET PILE WALLS.
- SEE SECTION 02125 OF TECHNICAL SPECIFICATIONS FOR ADDITIONAL DETAILS AND REQUIREMENTS RELATED TO THE SPECIFIED TEMPORARY EROSION AND SEDIMENT CONTROL OPERATIONS.

REFERENCES

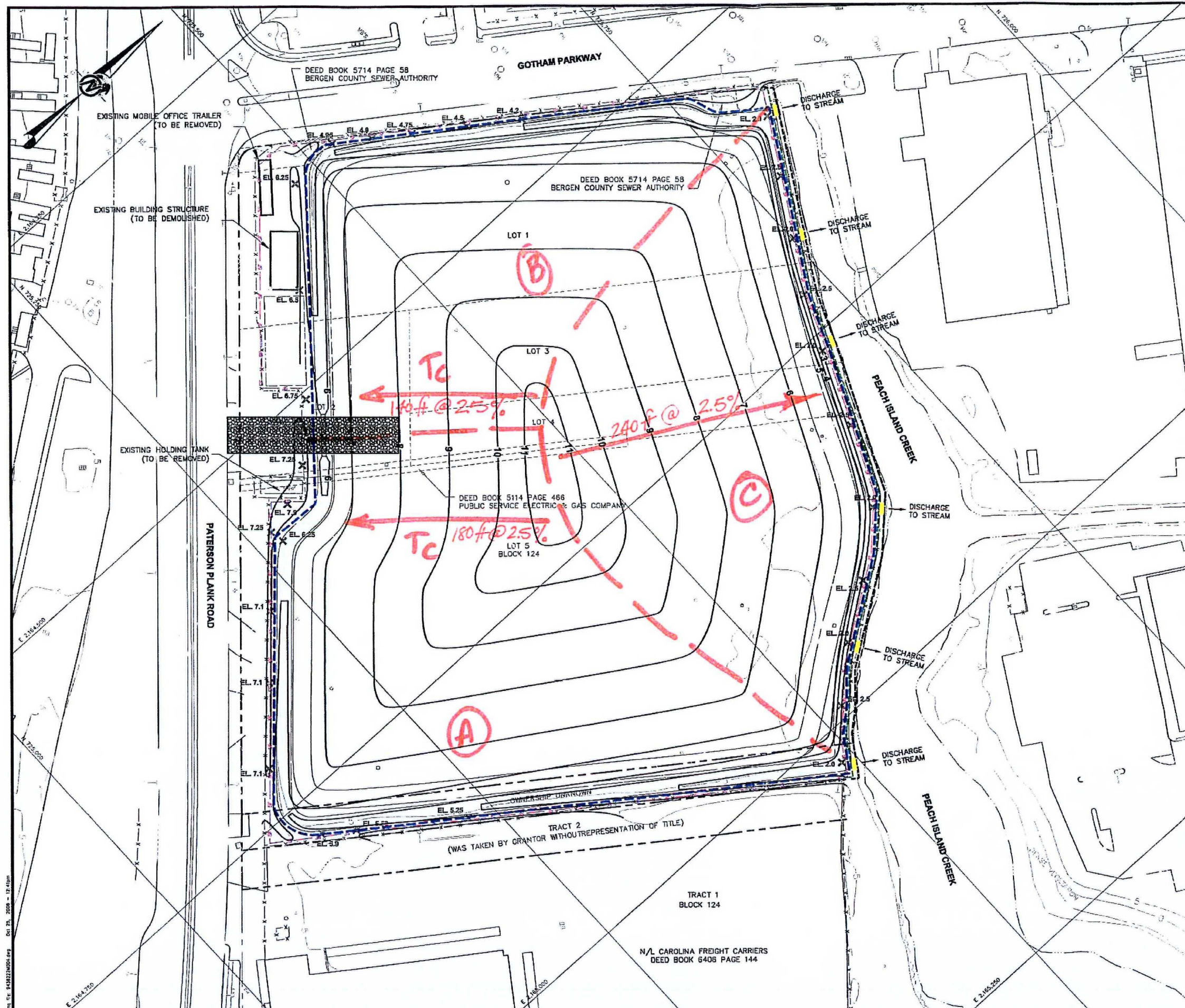
- BASE MAP SHOWN TAKEN FROM DIGITAL FILE 3074-02-TOPO.DWG, ENTITLED "BOROUGH OF CARLSTADT BLOCK 124 LOTS 1 THROUGH 5," DATED DECEMBER 8, 2005, PREPARED BY PROMAPS.
- HORIZONTAL DATUM REFERENCES THE NEW JERSEY STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83). VERTICAL DATUM REFERENCES THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).



REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	R/W
PROJECT						
216 PATERSON PLANK ROAD SITE						
PRE-FINAL (95%) DESIGN REPORT FOR OU-2						
CARLSTADT, BERGEN COUNTY, NEW JERSEY						
TITLE						
SOIL EROSION AND SEDIMENT CONTROL PLAN						
No Authorization #246A-28025100						
PROJECT No.			943-6222	FILE No.		
DESIGN			VEF 10/10/06	SCALE		
CADD			RG 10/10/06	AS SHOWN		
CHECK				REV.		
REVIEW						



FIGURE 6



Drawn by: 9436222M004.dwg
Date: 10/10/06
Scale: 1/8" = 1'-0"

Table 2-2a.—Runoff curve numbers for urban areas¹

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area ²	A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc.) ³ :					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) ⁴ ...		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
<i>Developing urban areas</i>					
Newly graded areas (pervious areas only, no vegetation) ⁵		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

¹Average runoff condition, and $I_a = 0.2S$.²The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.³CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.⁴Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.⁵Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4, based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Time of Concentration Calculation

Sheet 8 of 15

Project Carlstadt

By: VEF

Date: 10/25/2006

Location Carlstadt, New Jersey

Checked: _____

Date: _____

Condition Closure - vegetated

Watershed	A	B	C	
SHEET FLOW (Application to T_c only)	Segment 1	Segment 1	Segment 1	
1. Surface Description	vegetated	vegetated	vegetated	
2. Manning's roughness coefficient, n	0.24	0.24	0.24	
3. Flow Length, L (total L<300ft) ft.	180	140	240	
4. Two-yr 24-hr rainfall, P ₂ in.	3.3	3.3	3.3	
5. Land slope, s ft./ft.	0.025	0.025	0.025	
6. $T_1 = \frac{0.007 (nL)^{0.8} \text{ hr.}}{P_2^{0.5} s^{0.4}}$	0.343	0.280	0.432	
Shallow Concentrated Flow				
7. Surface description (paved or unpaved)				
8. Flow Length, L ft.				
9. Watercourse slope, s ft./ft.				
10. Average velocity, V (figure 3-1) ft./s.				
11. T _T = L _____ hr.				
3600V				
Channel Flow				
12. Cross Sectional flow area, a ft. ²				
13. Wetted perimeter, p _w ft.				
14. Hydraulic radius, r = a/p _w ft.				
15. Channel slope, s ft./ft.				
16. Manning's roughness coefficient, n				
17. $V = \frac{1.49 r^{2/3} s^{1/2} \text{ ft./s.}}{n}$				
18. Flow Length, L ft.				
19. T _t = L/3600 V hr.				
20. Total T _c from sheet, shallow, and channel flow hr.	0.343	0.280		0.432

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 10-25-2006 13:10:19
Watershed file: --> c:\pondpack\CLST-25 .WSD
Hydrograph file: --> c:\pondpack\CLST-25 .HYD

PRELIMINARY PERIMETER CHANNEL DESIGN

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
A	2.14	79.0	0.30	0.00	6.25	3.90	.09 .10
B	1.30	79.0	0.30	0.00	6.25	3.90	.09 .10
C	2.51	79.0	0.40	0.00	6.25	3.90	.09 .10

* Travel time from subarea outfall to composite watershed outfall point.
Total area = 5.95 acres or 0.00930 sq.mi
Peak discharge = 17 cfs

>>>> Computer Modifications of Input Parameters <<<<

Subarea Description	Input Values		Rounded Values		Ia/p	
	Tc (hr)	* Tt (hr)	Tc (hr)	* Tt (hr)	Interpolated (Yes/No)	Ia/p Messages
A	0.34	0.00	0.30	0.00	No	Computed Ia/p < .1
B	0.28	0.00	0.30	0.00	No	Computed Ia/p < .1
C	0.43	0.00	0.40	0.00	No	Computed Ia/p < .1

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 10-25-2006 13:10:19
Watershed file: --> c:\pondpack\CLST-25 .WSD
Hydrograph file: --> c:\pondpack\CLST-25 .HYD

PRELIMINARY PERIMETER CHANNEL DESIGN

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
A	6	12.3
B	4	12.4
C	7	12.5
-----	-----	-----
Composite Watershed	17	12.5

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 10-25-2006 13:10:19
 Watershed file: --> c:\pondpack\CLST-25 .WSD
 Hydrograph file: --> c:\pondpack\CLST-25 .HYD

PRELIMINARY PERIMETER CHANNEL DESIGN

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
A	0	0	1	1	2	2	4	6	6
B	0	0	0	1	1	1	2	3	4
C	0	0	1	1	1	2	3	5	6
Total (cfs)	0	0	2	3	4	5	9	14	16

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
A	6	5	4	3	2	1	1	1	1
B	4	3	2	2	1	1	1	0	0
C	7	6	5	4	2	2	1	1	1
Total (cfs)	17	14	11	9	5	4	3	2	2

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 10-25-2006 13:10:19
Watershed file: --> c:\pondpack\CLST-25 .WSD
Hydrograph file: --> c:\pondpack\CLST-25 .HYD

PRELIMINARY PERIMETER CHANNEL DESIGN

Composite Hydrograph Summary (cfs)

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
A	1	1	1	1	0	0	0	0	0
B	0	0	0	0	0	0	0	0	0
C	1	1	1	1	1	0	0	0	0
Total (cfs)	2	2	2	2	1	0	0	0	0

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
A	0	0	0	0	0
B	0	0	0	0	0
C	0	0	0	0	0
Total (cfs)	0	0	0	0	0

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 10-25-2006 13:10:19
Watershed file: --> c:\pondpack\CLST-25 .WSD
Hydrograph file: --> c:\pondpack\CLST-25 .HYD

PRELIMINARY PERIMETER CHANNEL DESIGN

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
11.0	0	14.8	2
11.1	0	14.9	2
11.2	0	15.0	2
11.3	0	15.1	2
11.4	1	15.2	2
11.5	1	15.3	1
11.6	2	15.4	1
11.7	2	15.5	1
11.8	3	15.6	1
11.9	3	15.7	1
12.0	4	15.8	0
12.1	5	15.9	0
12.2	9	16.0	0
12.3	14	16.1	0
12.4	16	16.2	0
12.5	17	16.3	0
12.6	14	16.4	0
12.7	11	16.5	0
12.8	9	16.6	0
12.9	7	16.7	0
13.0	5	16.8	0
13.1	4	16.9	0
13.2	4	17.0	0
13.3	4	17.1	0
13.4	3	17.2	0
13.5	3	17.3	0
13.6	2	17.4	0
13.7	2	17.5	0
13.8	2	17.6	0
13.9	2	17.7	0
14.0	2	17.8	0
14.1	2	17.9	0
14.2	2	18.0	0
14.3	2	18.1	0
14.4	2	18.2	0
14.5	2	18.3	0
14.6	2	18.4	0
14.7	2	18.5	0

TR-55 TABULAR HYDROGRAPH METHOD
Type III Distribution
(24 hr. Duration Storm)

Executed: 10-25-2006 13:10:19
Watershed file: --> c:\pondpack\CLST-25 .WSD
Hydrograph file: --> c:\pondpack\CLST-25 .HYD

PRELIMINARY PERIMETER CHANNEL DESIGN

Time (hrs)	Flow (cfs)	Time (hrs)	Flow (cfs)
18.6	0	22.4	0
18.7	0	22.5	0
18.8	0	22.6	0
18.9	0	22.7	0
19.0	0	22.8	0
19.1	0	22.9	0
19.2	0	23.0	0
19.3	0	23.1	0
19.4	0	23.2	0
19.5	0	23.3	0
19.6	0	23.4	0
19.7	0	23.5	0
19.8	0	23.6	0
19.9	0	23.7	0
20.0	0	23.8	0
20.1	0	23.9	0
20.2	0	24.0	0
20.3	0	24.1	0
20.4	0	24.2	0
20.5	0	24.3	0
20.6	0	24.4	0
20.7	0	24.5	0
20.8	0	24.6	0
20.9	0	24.7	0
21.0	0	24.8	0
21.1	0	24.9	0
21.2	0	25.0	0
21.3	0	25.1	0
21.4	0	25.2	0
21.5	0	25.3	0
21.6	0	25.4	0
21.7	0	25.5	0
21.8	0	25.6	0
21.9	0	25.7	0
22.0	0	25.8	0
22.1	0	25.9	0
22.2	0		
22.3	0		

Disk: Carlstadt
File:

Client: PRP Group

Date: 10/25/06
Time: 12:05

Title: Preliminary Design	Site: Carlstadt Site		
Prepared by: VEFoster		Sheet	of

Design Calculations:					PROPOSED PERIMETER RUNON CHANNEL VERIFICATION											
Channel Class	Peak Discharge (cfs)	Channel Bed Slope (ft/ft)	Free-board (ft)	Channel Lining	Manning Coeff.	Channel Bottom Width (ft)	Left Side Slopes Inclination	Right Side Slopes Inclination	Flow Area (sq.ft.)	Flow Depth (ft)	Top Flow Width (ft.)	Flow Velocity (ft/s)	Actual Q (cfs)	With Freeboard		
														Channel Depth (ft)	Top Channel Width (ft)	Q Available (cfs)
A	6.0	0.005	0.51	GRASS	0.033	3.00	2.00	2.00	3.02	0.69	5.76	2.00	6.0	1.20	7.8	17.4
A	6.0	0.015	0.69	GRASS	0.033	3.00	2.00	2.00	2.05	0.51	5.04	2.94	6.0	1.20	7.8	30.1
B	4.0	0.005	0.65	GRASS	0.033	3.00	2.00	2.00	2.26	0.55	5.20	1.77	4.0	1.20	7.8	17.4
B	4.0	0.015	0.79	GRASS	0.033	3.00	2.00	2.00	1.57	0.41	4.64	2.60	4.1	1.20	7.8	30.1
C	7.0	0.005	0.45	GRASS	0.033	3.00	2.00	2.00	3.38	0.75	6.00	2.09	7.0	1.20	7.8	17.4
C	7.0	0.015	0.64	GRASS	0.033	3.00	2.00	2.00	2.31	0.56	5.24	3.09	7.1	1.20	7.8	30.1

Sheet 15 of 15

GOLDER ASSOCIATES	Subject: Geocomposite – Head estimate		
	Job No. 943-6222	Made by VEF	Date 10/25/2006
	Ref. Carlstadt	Checked <i>MEM</i>	Sheet 1 of 4
		Reviewed <i>MEM</i>	

Objective: Determine the peak daily head on the geomembrane and determine the percent of infiltration reduction.

Method: Use the USEPA "HELP" (Hydrological Evaluation of Landfill Performance). Model Version 3.07 to estimate head for the following scenarios:

File Name	Slope/length	Topsoil/Cover Soil k*
CL-3	2.5% for 240 feet	1×10^{-4} cm/sec
CL-3a	2.5% for 240 feet	1.7×10^{-3} cm/sec

k* = saturated hydraulic conductivity

The HELP model is a program developed for the USEPA by Paul R. Schroeder, et al, of the Army Corps of Engineers Waterways Experiment Station in Vicksburg, Mississippi. This model accepts climatological and soil design data, and utilizes a solution technique, which accounts for the effects of surface storage, run-off, infiltration, percolation, evapotranspiration, soil moisture storage and lateral drainage.

- References:**
- 1) "HELP" program and user's manual, Version 3.07, 1997.
 - 2) Figure entitled, "Grading and Surface Water Management Plan," prepared by Golder Associates, dated 11/10/05.
 - 3) Figure entitled, "Grading and Surface Water Management System Details," prepared by Golder Associates, dated 11/10/05.
 - 4) "Designing with Geosynthetics," 4th edition, R. Koerner, 1998

- Assumptions:**
- 1) Runoff curve number is selected by the model.
 - 2) Fair grass was used.
 - 3) The 'initial soil water content' for all Cases is set by the model.
 - 4) The climatological data for the site was synthetic data generated by the model for Newark, New Jersey.
 - 5) Each Case was evaluated for a period of twenty years.
 - 6) The evaporative zone depth selected for fair grass (under final cover conditions) is 20 inches
 - 7) Runoff was allowed from 100% of the site.
 - 8) Each model was simulated for 1-acre area.
 - 9) k* for the geocomposite drainage layer is 3.3 cm/sec after reducing published values for the creep, clogging, and other factors recommended by Koerner (Ref. 4).

Notes: 1) The HELP default soil types were used.

GOLDER ASSOCIATES	Subject: Geocomposite – Head estimate		
	Job No. 943-6222	Made by VEF	Date 10/25/2006
	Ref. Carlstadt	Checked <i>Mfm</i>	Sheet 2 of 4
		Reviewed <i>Mfm</i>	

Results:

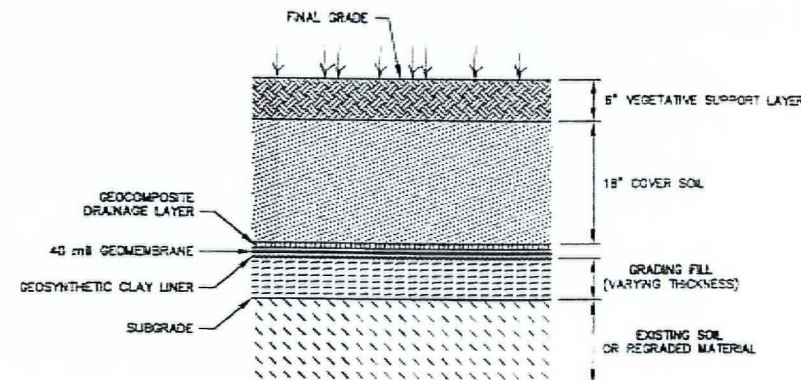
File Name	Slope/length	Topsoil/Cover Soil k*	Average Annual Infiltration (inches)	Max Head "Peak Daily" (inches)
CL-3	2.5% for 240 feet	1×10^{-4} cm/sec	0.00002	20.1
CL-3a	2.5% for 240 feet	1.7×10^{-3} cm/sec	0.00004	19.9

k* = saturated hydraulic conductivity

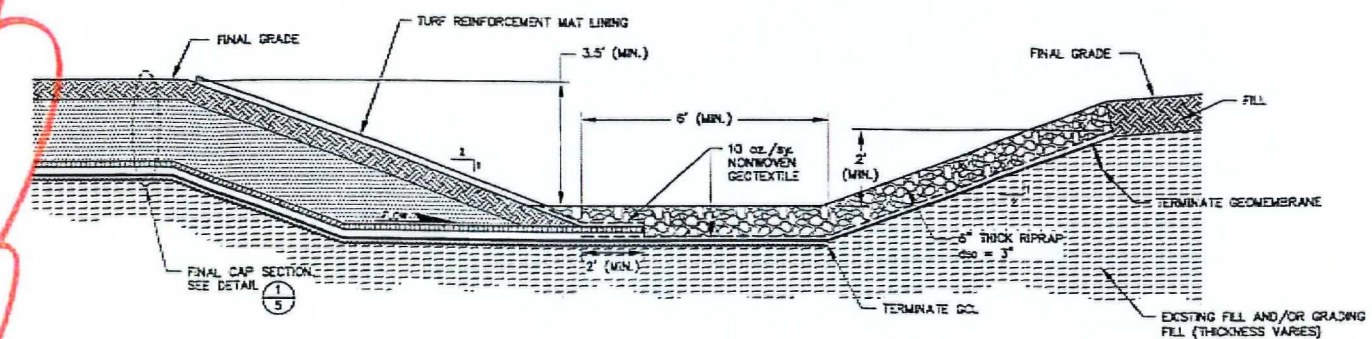
The estimated maximum head buildup (approximately 20 inches, regardless of the k*) is not a concern for slope stability.

The models demonstrate that, under the average annual conditions, the closure cap system is effective in preventing in excess of 99.9% of the rainfall from leaking through the geomembrane.

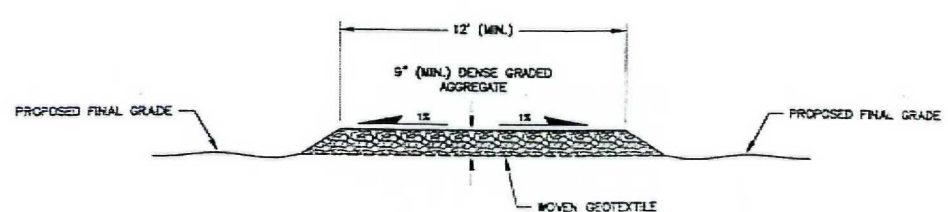
sheet 3 of 4



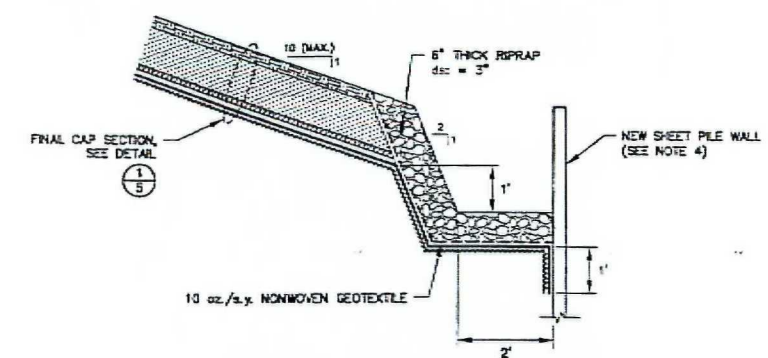
1
5 FINAL CAP SECTION
NOT TO SCALE
(SEE NOTE 1)



2
5 TYPICAL PERIMETER DRAINAGE CHANNEL DETAIL
NOT TO SCALE
(SEE NOTES 1, 2 AND 5)



3
5 ACCESS ROAD ON FINAL COVER
NOT TO SCALE
(SEE NOTE 3)



4
5 PERIMETER DRAINAGE CHANNEL ALONG NEW SHEET PILE WALL
NOT TO SCALE
(SEE NOTES 1, 2, 4 AND 5)

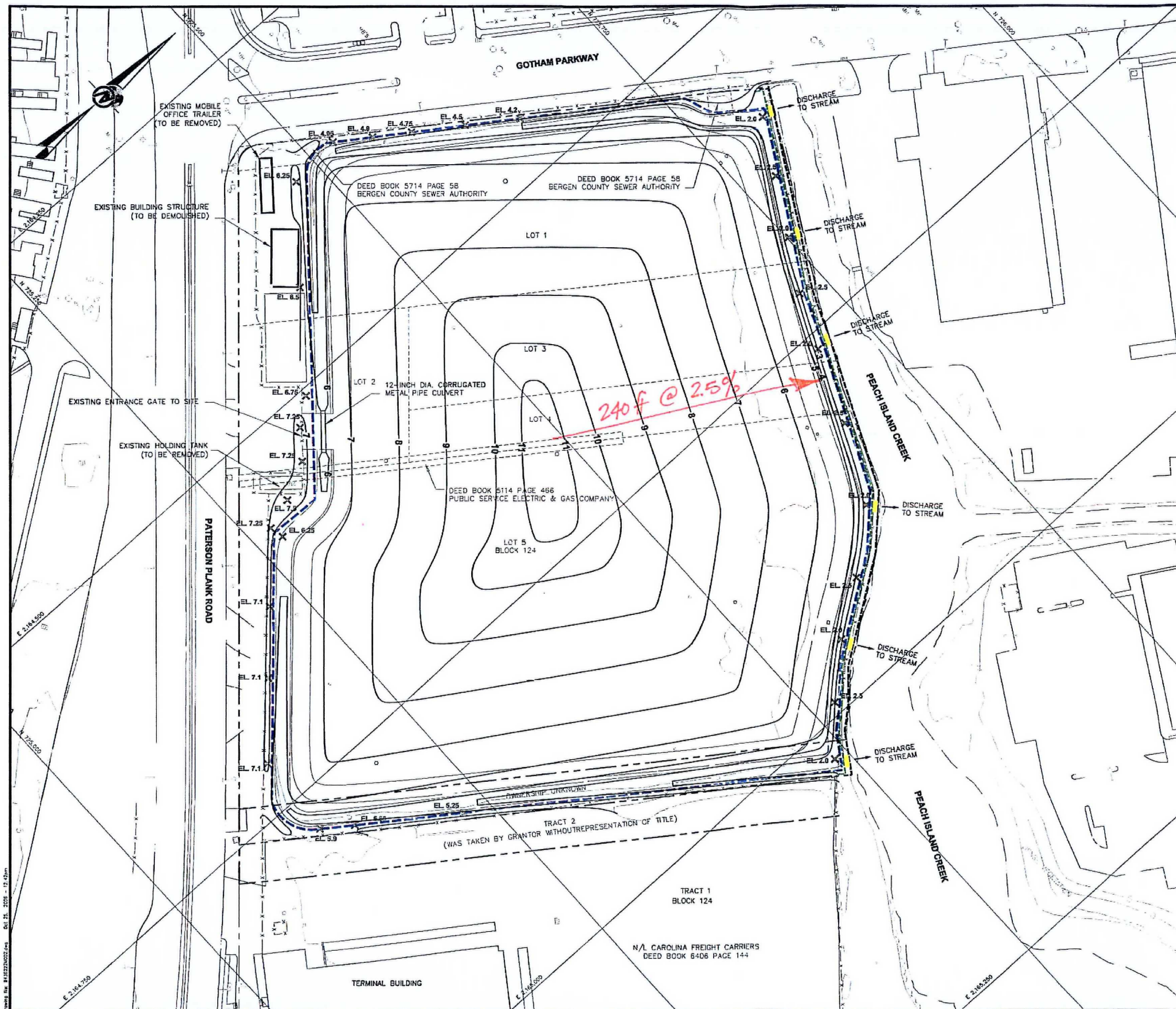
NOTES

- 1.) GEOSYNTHETICS THICKNESSES ARE EXAGGERATED FOR CLARITY.
- 2.) THE MINIMUM AND MAXIMUM SLOPES ALONG THE PERIMETER CHANNELS ARE 0.5% AND 1.5%, RESPECTIVELY.
- 3.) LIMITS AND ALIGNMENTS OF THE PROPOSED ACCESS ROADS WILL BE ESTABLISHED DURING THE PRE-FINAL DESIGN PHASE, AND WILL FACILITATE ACCESS TO THE ENTIRE SITE PERIMETER.
- 4.) THE NEW SHEET PILE WALL WILL BE INSTALLED BETWEEN THE EXISTING SLURRY AND SHEET PILE WALLS. SEE DETAIL 3 ON FIGURE 11 FOR ADDITIONAL INFORMATION.
- 5.) PERIMETER DRAINAGE CHANNEL, ALONG THE NEW SHEET PILE WALL, WILL DISCHARGE TO PEACH ISLAND CREEK THROUGH A SERIES OF NOTCHED WEIRS, AS SIMILAR TO THE EXISTING CONDITIONS. LOCATIONS AND DETAILS FOR THESE DISCHARGE WEIRS WILL BE ESTABLISHED DURING THE PRE-FINAL DESIGN PHASE.
- 6.) TERMINATION DETAILS FOR THE PROPOSED GCL AND GEOMEMBRANE WILL BE ESTABLISHED DURING THE PRE-FINAL DESIGN PHASE.

REV	DATE	DES	REVISION DESCRIPTION	CADD	C-K	REV
PROJECT			216 PATERSON PLANK ROAD SITE PRELIMINARY (35%) DESIGN REPORT FOR OU-2 CARLSTADT, BERGEN COUNTY, NEW JERSEY			
TITLE			GRADING AND SURFACE WATER MANAGEMENT SYSTEM DETAILS			
PROJECT No. 943-6222			FILE No. 9436222003			
DESIGN	CDH	12/06/05	SCALE	AS SHOWN	REV.	0
CADD	RG	12/06/05				
CHECK	COH	12/16/05				
REVIEW	MAF	12/16/05				



FIGURE 5



- LEGEND**
- 5 — EXISTING GROUND CONTOURS
 - — — — — EDGE OF STREAM
 - x - x - x - EXISTING FENCE
 - - - - - PROPERTY LINE
 - - - - - EXISTING SHEET PILE WALL (TO BE PARTIALLY REMOVED)
 - - - - - NEW SHEET PILE WALL (SEE FIGURES 13 AND 14)
 - WEIR (SEE NOTE 5)
 - X EL. 2.5 SPOT ELEVATION
 - - - - - LIMITS OF NEW GEOMEMBRANE (SEE NOTE 3)
 - - - - - PROPOSED GROUND CONTOURS
 - - - - - PERIMETER DRAINAGE CHANNEL (SEE DETAILS (2/5) AND (4/5))
 - - - - - NEW PERIMETER ACCESS ROAD AND PARKING AREAS (SEE DETAILS (3/5) AND (5/5))

- NOTES**
- 1.) ALL LOCATIONS ARE APPROXIMATE.
 - 2.) CONTRACTOR MAY ELECT TO REMOVE PORTIONS OF THE PERIMETER FENCE DURING CONSTRUCTION TO ACCOMMODATE ITS ACTIVITIES. IN THAT EVENT, CONTRACTOR SHALL PROVIDE TEMPORARY ACCESS RESTRICTIONS IN AREAS WHERE THE EXISTING FENCE IS REMOVED, AND SHALL RESTORE FENCE TO ORIGINAL CONDITION, OR BETTER, UPON COMPLETION OF CONSTRUCTION.
 - 3.) LIMITS OF THE NEW GEOMEMBRANE SHALL COINCIDE WITH THE LIMITS OF THE EXISTING GEOMEMBRANE.
 - 4.) CONTRACTOR SHALL PROTECT ALL STRUCTURES, FENCELINES, WELLS, AND OTHER SITE FEATURES DURING CONSTRUCTION, UNLESS INDICATED OTHERWISE ON THESE DRAWINGS, OR AS DIRECTED BY THE GROUP'S REPRESENTATIVE. THE CONTRACTOR SHALL REPLACE ANY DAMAGED ITEMS AT ITS SOLE EXPENSE.
 - 5.) SURFACE WATER FLOWS SHALL BE CONVEYED TO PEACH ISLAND CREEK VIA THE PERIMETER DRAINAGE CHANNELS, AND DISCHARGE TO CREEK THROUGH A SERIES OF WEIRS IN THE TOPS OF THE NEW SHEET PILE WALLS.

- REFERENCES**
- 1.) BASE MAP SHOWN TAKEN FROM DIGITAL FILE 3074-02-TOPO.DWG, ENTITLED "BOROUGH OF CARLSTADT BLOCK 124 LOTS 1 THROUGH 5," DATED DECEMBER 8, 2005, PREPARED BY FROMAPS.
 - 2.) HORIZONTAL DATUM REFERENCES THE NEW JERSEY STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83). VERTICAL DATUM REFERENCES THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).




REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
PROJECT			216 PATERSON PLANK ROAD SITE PRE-FINAL (95%) DESIGN REPORT FOR OU-2 CARLSTADT, BERGEN COUNTY, NEW JERSEY			
TITLE			GRADING AND DRAINAGE PLAN			
		PROJECT No.	943-6222	FILE No.	9436222M002	
		DESIGN	VEF 10/10/06	SCALE	AS SHOWN	
		CADD	RG 10/10/06	SCALE	AS SHOWN	
		CHECK		SCALE	AS SHOWN	
		REVIEW		SCALE	AS SHOWN	
		REVIEW		SCALE	AS SHOWN	

FIGURE 4

CL-3

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**
**          HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE          **
**          HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)             **
**          DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**          USAE WATERWAYS EXPERIMENT STATION                      **
**          FOR USEPA RISK REDUCTION ENGINEERING LABORATORY        **
**
**
*****
*****

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PRECIPITATION DATA FILE:  c:\help307\DATA4C.D4
TEMPERATURE DATA FILE:   c:\help307\DATA7C.D7
SOLAR RADIATION DATA FILE: c:\help307\DATA13C.D13
EVAPOTRANSPIRATION DATA: c:\help307\DATA11C.D11
SOIL AND DESIGN DATA FILE: c:\help307\CL-3.D10
OUTPUT DATA FILE:        c:\help307\cl-3.OUT

```

TIME: 13:54 DATE: 10/25/2006

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*****
TITLE:  CARLSTADT - 95% Design
*****

```

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 0

THICKNESS	=	6.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2450	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999975000E-04	CM/SEC

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 0

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3206	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999975000E-04	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.20	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.2008	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	3.29999995000	CM/SEC
SLOPE	=	2.50	PERCENT
DRAINAGE LENGTH	=	240.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER

MATERIAL TEXTURE NUMBER 36

THICKNESS	=	0.04	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.399999993000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3	- GOOD

LAYER 5

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.25	INCHES
POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08	CM/SEC

LAYER 6

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 7

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1890	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.520000001000E-03	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 4 WITH A
FAIR STAND OF GRASS, A SURFACE SLOPE OF 2. %
AND A SLOPE LENGTH OF 240. FEET.

SCS RUNOFF CURVE NUMBER	=	59.70	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	20.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	5.893	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.460	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.080	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	9.737	INCHES
TOTAL INITIAL WATER	=	9.737	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
NEWARK NEW JERSEY

STATION LATITUDE	=	40.70	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	

START OF GROWING SEASON (JULIAN DATE) = 108
 END OF GROWING SEASON (JULIAN DATE) = 301
 EVAPORATIVE ZONE DEPTH = 20.0 INCHES
 AVERAGE ANNUAL WIND SPEED = 10.20 MPH
 AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 64.00 %
 AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 61.00 %
 AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 66.00 %
 AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 68.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
 COEFFICIENTS FOR NEWARK NEW JERSEY

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.13	3.05	4.15	3.57	3.59	2.94
3.85	4.30	3.66	3.09	3.59	3.42

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
 COEFFICIENTS FOR NEWARK NEW JERSEY

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
31.30	32.80	41.20	52.10	62.30	71.50
76.80	75.50	68.20	57.20	46.50	35.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
 COEFFICIENTS FOR NEWARK NEW JERSEY
 AND STATION LATITUDE = 40.70 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.91	3.48	4.30	2.94	4.28	2.73
	3.80	4.46	3.64	2.31	3.11	3.74
STD. DEVIATIONS	1.32	1.39	2.19	1.26	2.36	1.34

	1.81	2.19	1.78	1.10	1.36	1.49
RUNOFF						

TOTALS	1.030	1.508	1.401	0.000	0.005	0.003
	0.000	0.028	0.035	0.000	0.001	0.020
STD. DEVIATIONS	1.329	0.915	1.945	0.001	0.016	0.014
	0.000	0.125	0.151	0.001	0.006	0.070

EVAPOTRANSPIRATION						

TOTALS	0.859	0.762	1.979	2.445	3.284	4.916
	3.803	3.781	2.624	1.272	1.254	0.944
STD. DEVIATIONS	0.317	0.354	0.496	0.574	1.227	0.837
	1.474	1.470	0.813	0.346	0.242	0.164

LATERAL DRAINAGE COLLECTED FROM LAYER 3						

TOTALS	1.0201	0.5819	2.3971	1.1043	1.1248	0.4577
	0.1555	0.0539	0.1955	0.1854	0.8174	1.6086
STD. DEVIATIONS	0.6831	0.9976	1.0104	1.0884	1.0705	0.4549
	0.1141	0.0407	0.5231	0.3185	1.1278	1.3954

PERCOLATION/LEAKAGE THROUGH LAYER 5						

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

PERCOLATION/LEAKAGE THROUGH LAYER 6						

TOTALS	0.0029	0.0025	0.0027	0.0025	0.0025	0.0023
	0.0023	0.0021	0.0013	0.0008	0.0014	0.0017
STD. DEVIATIONS	0.0041	0.0034	0.0034	0.0031	0.0029	0.0026
	0.0026	0.0021	0.0014	0.0013	0.0023	0.0021

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4						

AVERAGES	0.0583	0.1620	0.3151	0.0520	0.0795	0.0137
	0.0026	0.0009	0.0054	0.0031	0.1443	0.1130
STD. DEVIATIONS	0.1332	0.5688	0.3063	0.0849	0.1464	0.0328
	0.0019	0.0007	0.0173	0.0053	0.5421	0.2023

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	41.70 (6.518)		151374.6	100.00
RUNOFF	4.032 (2.9008)		14634.78	9.668
EVAPOTRANSPIRATION	27.922 (3.3909)		101357.94	66.958
LATERAL DRAINAGE COLLECTED FROM LAYER 3	9.70223 (2.93647)		35219.102	23.26619
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00002 (0.00002)		0.076	0.00005
AVERAGE HEAD ON TOP OF LAYER 4	0.079 (0.066)			
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.02509 (0.02968)		91.079	0.06017
CHANGE IN WATER STORAGE	0.020 (1.6565)		71.74	0.047

PEAK DAILY VALUES FOR YEARS 1 THROUGH 20		
	(INCHES)	(CU. FT.)
PRECIPITATION	4.02	14592.600
RUNOFF	3.039	11033.1953
DRAINAGE COLLECTED FROM LAYER 3	0.39076	1418.45154
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000012	0.04469
AVERAGE HEAD ON TOP OF LAYER 4	15.008	
MAXIMUM HEAD ON TOP OF LAYER 4	20.119	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	79.2 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000614	2.23015
SNOW WATER	4.38	15904.2266
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.4496
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.1040

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.8916	0.3153
2	6.2690	0.3483
3	0.0167	0.0836
4	0.0000	0.0000
5	0.1875	0.7500
6	1.7671	0.1473
SNOW WATER	0.000	

CL-3a

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**
**      HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE      **
**      HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)          **
**      DEVELOPED BY ENVIRONMENTAL LABORATORY                **
**      USAE WATERWAYS EXPERIMENT STATION                   **
**      FOR USEPA RISK REDUCTION ENGINEERING LABORATORY      **
**
**
*****
*****

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```

PRECIPITATION DATA FILE:  c:\help307\DATA4C.D4
TEMPERATURE DATA FILE:   c:\help307\DATA7C.D7
SOLAR RADIATION DATA FILE: c:\help307\DATA13C.D13
EVAPOTRANSPIRATION DATA:  c:\help307\DATA11C.D11
SOIL AND DESIGN DATA FILE: c:\help307\CL-3a.D10
OUTPUT DATA FILE:         c:\help307\cl-3a.OUT

```

TIME: 13:54 DATE: 10/25/2006

```

*****
TITLE:  CARLSTADT - 95% Design
*****

```

NOTE: INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.

LAYER 1

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 4

```

THICKNESS           = 6.00 INCHES
POROSITY             = 0.4370 VOL/VOL
FIELD CAPACITY       = 0.1050 VOL/VOL
WILTING POINT       = 0.0470 VOL/VOL
INITIAL SOIL WATER CONTENT = 0.1130 VOL/VOL
EFFECTIVE SAT. HYD. COND. = 0.170000002000E-02 CM/SEC

```

NOTE: SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY 3.00
FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 4

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.1050	VOL/VOL
WILTING POINT	=	0.0470	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1958	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.170000002000E-02	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.20	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1391	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	3.29999995000	CM/SEC
SLOPE	=	2.50	PERCENT
DRAINAGE LENGTH	=	240.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER

MATERIAL TEXTURE NUMBER 36

THICKNESS	=	0.04	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.399999993000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3	- GOOD

LAYER 5

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.25	INCHES
POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL
* INITIAL SOIL WATER CONTENT	=	0.7500	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08	CM/SEC

LAYER 6

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 7

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1872	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.520000001000E-03	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 4 WITH A
FAIR STAND OF GRASS, A SURFACE SLOPE OF 2. %
AND A SLOPE LENGTH OF 240. FEET.

SCS RUNOFF CURVE NUMBER	=	59.70	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	20.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.362	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	8.740	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.940	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	6.663	INCHES
TOTAL INITIAL WATER	=	6.663	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
NEWARK NEW JERSEY

STATION LATITUDE	=	40.70 DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	108
END OF GROWING SEASON (JULIAN DATE)	=	301
EVAPORATIVE ZONE DEPTH	=	20.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	10.20 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	64.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	61.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	66.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	68.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR NEWARK NEW JERSEY

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.13	3.05	4.15	3.57	3.59	2.94
3.85	4.30	3.66	3.09	3.59	3.42

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR NEWARK NEW JERSEY

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
31.30	32.80	41.20	52.10	62.30	71.50
76.80	75.50	68.20	57.20	46.50	35.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR NEWARK NEW JERSEY
AND STATION LATITUDE = 40.70 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.91	3.48	4.30	2.94	4.28	2.73
	3.80	4.46	3.64	2.31	3.11	3.74

STD. DEVIATIONS	1.32 1.81	1.39 2.19	2.19 1.78	1.26 1.10	2.36 1.36	1.34 1.49
RUNOFF						
TOTALS	0.814 0.000	1.231 0.003	1.227 0.000	0.000 0.000	0.000 0.000	0.000 0.010
STD. DEVIATIONS	1.114 0.000	0.808 0.012	1.796 0.002	0.000 0.000	0.000 0.000	0.000 0.036
EVAPOTRANSPIRATION						
TOTALS	0.879 3.371	0.762 3.676	1.989 2.555	2.444 1.398	3.286 1.394	4.012 1.018
STD. DEVIATIONS	0.327 1.474	0.361 1.487	0.500 0.840	0.607 0.413	1.254 0.225	1.182 0.167
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	0.9387 0.2018	0.6820 0.3444	3.0482 0.4841	0.9856 0.4482	1.1404 1.0530	0.4689 1.7916
STD. DEVIATIONS	0.8208 0.1895	1.2155 0.5380	1.2559 0.7140	1.1112 0.4629	1.1167 1.0300	0.4703 1.3643
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
STD. DEVIATIONS	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000	0.0000 0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6						
TOTALS	0.0025 0.0021	0.0022 0.0020	0.0023 0.0019	0.0022 0.0019	0.0022 0.0018	0.0021 0.0018
STD. DEVIATIONS	0.0036 0.0023	0.0030 0.0022	0.0031 0.0020	0.0028 0.0020	0.0027 0.0018	0.0024 0.0018
AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)						
DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	0.0856 0.0033	0.2318 0.0274	0.9243 0.0412	0.0860 0.0102	0.1030 0.1161	0.0187 0.1340
STD. DEVIATIONS	0.2717 0.0031	0.6153 0.0768	0.7574 0.1178	0.1482 0.0145	0.1649 0.3789	0.0517 0.2010

*
AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	41.70	(6.518)	151374.6	100.00
RUNOFF	3.284	(2.6271)	11921.95	7.876
EVAPOTRANSPIRATION	26.784	(3.4598)	97226.22	64.229
LATERAL DRAINAGE COLLECTED FROM LAYER 3	11.58685	(3.07783)	42060.266	27.78555
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00004	(0.00002)	0.135	0.00009
AVERAGE HEAD ON TOP OF LAYER 4	0.148	(0.080)		
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.02491	(0.02962)	90.424	0.05974
CHANGE IN WATER STORAGE	0.021	(1.6688)	75.76	0.050

PEAK DAILY VALUES FOR YEARS			1 THROUGH	20
			(INCHES)	(CU. FT.)
* PRECIPITATION			4.02	14592.600
RUNOFF			2.822	10244.4541
DRAINAGE COLLECTED FROM LAYER 3			0.40439	1467.93848
PERCOLATION/LEAKAGE THROUGH LAYER 5			0.000012	0.04390
AVERAGE HEAD ON TOP OF LAYER 4			14.828	
MAXIMUM HEAD ON TOP OF LAYER 4			19.918	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)			78.8 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 6			0.000540	1.95850
SNOW WATER			4.38	15904.2266
MAXIMUM VEG. SOIL WATER (VOL/VOL)				0.3909
MINIMUM VEG. SOIL WATER (VOL/VOL)				0.0470

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.0570	0.1762
2	3.9176	0.2176
3	0.1700	0.8500
4	0.0000	0.0000
5	0.1875	0.7500
6	1.7485	0.1457
SNOW WATER	0.000	

GOLDER ASSOCIATES	Subject: Geocomposite – Head estimate		
	Job No. 943-6222	Made by VEF	Date 11/3/05
	Ref. Carlstadt	Checked <i>CBM</i>	Sheet 1 of 4
		Reviewed <i>[Signature]</i>	

Objective: Determine the peak daily head on the geomembrane and determine the percent of infiltration reduction.

Method: Use the USEPA "HELP" (Hydrological Evaluation of Landfill Performance). Model Version 3.07 to estimate head for the following scenarios:

File Name	Slope/length	Topsoil/Cover Soil k*
CL-3	3% for 180 feet	1×10^{-4} cm/sec
CL-3a	3% for 180 feet	1.7×10^{-3} cm/sec
CL-10	10% for 120 feet	1×10^{-4} cm/sec
CL-10a	10% for 120 feet	1.7×10^{-3} cm/sec

k* = saturated hydraulic conductivity

The HELP model is a program developed for the USEPA by Paul R. Schroeder, et al, of the Army Corps of Engineers Waterways Experiment Station in Vicksburg, Mississippi. This model accepts climatological and soil design data, and utilizes a solution technique, which accounts for the effects of surface storage, run-off, infiltration, percolation, evapotranspiration, soil moisture storage and lateral drainage.

- References:**
- 1) "HELP" program and user's manual, Version 3.07, 1997.
 - 2) Figure entitled, "Grading and Surface Water Management Plan," prepared by Golder Associates, dated 11/10/05.
 - 3) Figure entitled, "Grading and Surface Water Management System Details," prepared by Golder Associates, dated 11/10/05.
 - 4) "Designing with Geosynthetics," 4th edition, R. Koerner, 1998

Assumptions:

- 1) Runoff curve number is selected by the model.
- 2) Fair grass was used.
- 3) The 'initial soil water content' for all Cases is set by the model.
- 4) The climatological data for the site was synthetic data generated by the model for Newark, New Jersey.
- 5) Each Case was evaluated for a period of twenty years.
- 6) The evaporative zone depth selected for fair grass (under final cover conditions) is 20 inches
- 7) Runoff was allowed from 100% of the site.
- 8) Each model was simulated for 1-acre area.
- 9) k* for the geocomposite drainage layer is 3.3 cm/sec after reducing published values for the creep, clogging, and other factors recommended by Koerner (Ref. 4).

GOLDER ASSOCIATES	Subject: Geocomposite – Head estimate		
	Job No. 943-6222	Made by VEF	Date 11/3/05
	Ref. Carlstadt	Checked <i>CBM</i>	Sheet 2 of 4
		Reviewed <i>[Signature]</i>	

Notes: 1) The HELP default soil types were used.

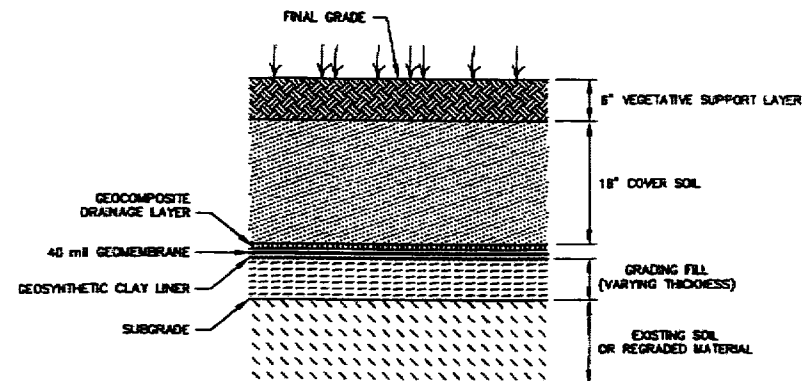
Results:

File Name	Slope/length	Topsoil/Cover Soil k*	Average Annual Infiltration (inches)	Max Head "Peak Daily" (inches)
CL-3	3% for 180 feet	1×10^{-4} cm/sec	0.00001	16.42
CL-3a	3% for 180 feet	1.7×10^{-3} cm/sec	0.00002	18.56
CL-10	10% for 120 feet	1×10^{-4} cm/sec	0.00000	0.17
CL-10a	10% for 120 feet	1.7×10^{-3} cm/sec	0.00001	5.09

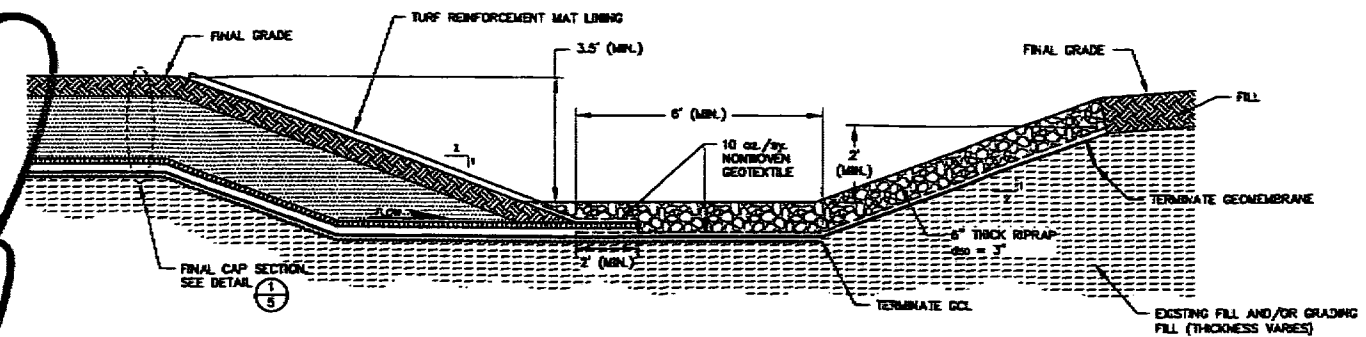
k* = saturated hydraulic conductivity

In the flatter sloped areas (i.e., 3%), the estimated maximum head buildup (between 11 and 18 inches, depending upon the k*) is not a concern for slope stability. The nominal head buildup on the steeper slopes (i.e, 10%) is also not anticipated to be a concern for slope stability, but will be checked in the veneer stability calculations.

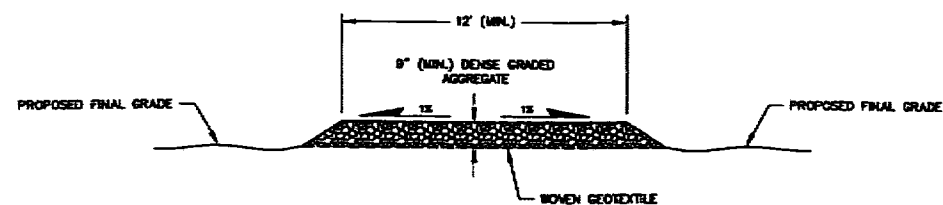
The models demonstrate that, under the average annual conditions, the closure cap system is effective in preventing in excess of 99.9% of the rainfall from leaking through the geomembrane.



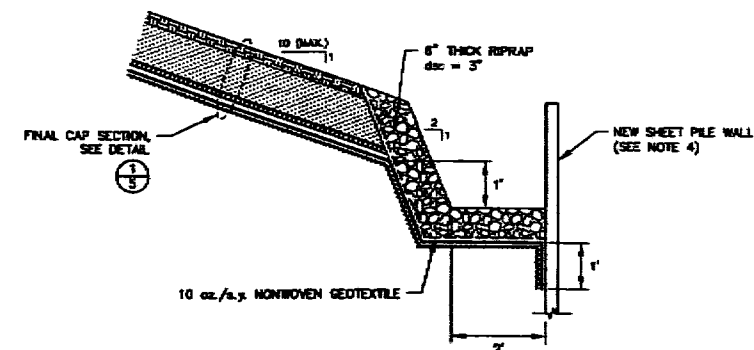
1
5 **FINAL CAP SECTION**
NOT TO SCALE
(SEE NOTE 1)



2
5 **TYPICAL PERIMETER DRAINAGE CHANNEL DETAIL**
NOT TO SCALE
(SEE NOTES 1, 2 AND 5)



3
5 **ACCESS ROAD ON FINAL COVER**
NOT TO SCALE
(SEE NOTE 3)



4
5 **PERIMETER DRAINAGE CHANNEL ALONG NEW SHEET PILE WALL**
NOT TO SCALE
(SEE NOTES 1, 2, 4 AND 5)

NOTES

- 1.) GEOSYNTHETICS THICKNESSES ARE EXAGGERATED FOR CLARITY.
- 2.) THE MINIMUM AND MAXIMUM SLOPES ALONG THE PERIMETER CHANNELS ARE 0.5% AND 1.5%, RESPECTIVELY.
- 3.) LIMITS AND ALIGNMENTS OF THE PROPOSED ACCESS ROADS WILL BE ESTABLISHED DURING THE PRE-FINAL DESIGN PHASE, AND WILL FACILITATE ACCESS TO THE ENTIRE SITE PERIMETER.
- 4.) THE NEW SHEET PILE WALL WILL BE INSTALLED BETWEEN THE EXISTING SLURRY AND SHEET PILE WALLS. SEE DETAIL 3 ON FIGURE 11 FOR ADDITIONAL INFORMATION.
- 5.) PERIMETER DRAINAGE CHANNEL ALONG THE NEW SHEET PILE WALL WILL DISCHARGE TO PEACH ISLAND CREEK THROUGH A SERIES OF NOTCHED WEIRS, AS SIMILAR TO THE EXISTING CONDITIONS. LOCATIONS AND DETAILS FOR THESE DISCHARGE WEIRS WILL BE ESTABLISHED DURING THE PRE-FINAL DESIGN PHASE.
- 6.) TERMINATION DETAILS FOR THE PROPOSED GCL AND GEOMEMBRANE WILL BE ESTABLISHED DURING THE PRE-FINAL DESIGN PHASE.

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	APP
PROJECT: 216 PATERSON PLANK ROAD SITE PRELIMINARY (35%) DESIGN REPORT FOR OU-2 CARLSTADT, BERGEN COUNTY, NEW JERSEY						
TITLE: GRADING AND SURFACE WATER MANAGEMENT SYSTEM DETAILS						
PROJECT No. 943-6222			FILE No. 9436222003			
DESIGN	CDH	12/08/05	SCALE AS SHOWN / REV. 0			
CADD	RD	12/08/05				
CHECK	CDH	12/16/05				
REVIEW	JAN FUM	12/16/05				



FIGURE 5

LEGEND *Sheet 4 of 4*

- EXISTING GROUND CONTOUR
- EDGE OF STREAM
- FENCE (SEE NOTE 4)
- UTILITY POLE
- FINISHED GRADE ELEVATION (FEET) (SEE NOTE 1)
- EXISTING SLURRY WALL
- EXISTING SHEET PILE WALL (SEE NOTE 8)
- LIMITS OF EXISTING GEOMEMBRANE
- VEGETATED CAP LIMITS
- LIMITS OF NEW GEOMEMBRANE (SEE NOTE 5)
- PERIMETER DRAINAGE CHANNEL (SEE DETAILS 2 AND 3)
- SURFACE WATER FLOW DIRECTION
- APPROXIMATE LIMITS OF SLUDGE AREA (SEE REFERENCE 2)

NOTES

- 1.) FINISHED GRADES SHOWN HEREIN REPRESENT THE TOP OF PROPOSED FINAL CAP WITHIN THE LIMITS OF THE NEW GEOMEMBRANE. SEE DETAIL 1 ON FIGURE 3 FOR CAP TRANSITION DETAILS TO EXISTING GRADES.
- 2.) FINISHED GRADES SHOWN HEREIN REPRESENT CONCEPTUAL DESIGN CONDITIONS WHICH ARE INTENDED TO PRIMARILY SHOW SURFACE WATER DRAINAGE PATTERNS. FINAL GRADES WILL BE ESTABLISHED DURING THE PRE-FINAL DESIGN PHASE.
- 3.) REFER TO FIGURES 6 AND 7 FOR TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES LAYOUT AND DETAILS, RESPECTIVELY.
- 4.) THE CONTRACTOR MAY ELECT TO REMOVE PORTIONS OF THE PERIMETER FENCE DURING CONSTRUCTION TO ACCOMMODATE ACTIVITIES ALONG PERIMETER OF THE SITE. IN THAT EVENT, THE CONTRACTOR SHALL PROVIDE TEMPORARY ACCESS RESTRICTIONS IN AREAS WHERE THE FENCE IS REMOVED, AND SHALL RESTORE FENCE TO ORIGINAL CONDITION, OR BETTER, FOLLOWING CONSTRUCTION.
- 5.) THE NEW GEOMEMBRANE SHALL EXTEND BEYOND THE LIMIT OF THE SLURRY WALL, AND GENERALLY COINCIDE WITH THE LIMITS OF THE EXISTING GEOMEMBRANE.
- 6.) THE CONTRACTOR SHALL PROTECT ALL STRUCTURES, FENCELINE, WELLS, AND OTHER FEATURES DURING CONSTRUCTION, UNLESS INDICATED OTHERWISE ON THESE DRAWINGS, OR AS DIRECTED BY THE GROUP'S REPRESENTATIVE. THE CONTRACTOR SHALL REPLACE ANY DAMAGED ITEMS AT HIS SOLE EXPENSE.
- 7.) THE PERIMETER DRAINAGE CHANNELS WILL BE DESIGNED TO HAVE MINIMUM AND MAXIMUM SLOPES OF 0.5% AND 1.5%, RESPECTIVELY. PERIMETER DRAINAGE CHANNELS ALONG THE NEW SHEET PILE WALL WILL DISCHARGE TO PEACH ISLAND CREEK THROUGH A SERIES OF NOTCHED WEIRS, AS SIMILAR TO THE EXISTING CONDITIONS.
- 8.) A NEW STEEL SHEET PILE WALL WILL BE INSTALLED ABOUT 5 FEET BEHIND THE EXISTING SHEET PILE WALL. FOLLOWING INSTALLATION OF THE NEW SHEET PILE WALL, THE EXISTING SHEET PILE WALL WILL BE REMOVED DOWN TO THE ADJACENT PEACH ISLAND CREEK LOW TIDE LEVELS, AND THE FILL MATERIAL BETWEEN THESE WALLS WILL BE EXCAVATED AND POSSIBLY USED AS SITE GRADING FILL. SEE DETAIL 3 ON FIGURE 11 FOR ADDITIONAL INFORMATION.

REFERENCES

- 1.) TOPOGRAPHIC DATA AND SURFACE FEATURES TAKEN FROM DRAWING PROVIDED BY TAYLOR, WISEMAN & TAYLOR CONSULTING ENGINEERS/SURVEYORS/PLANNERS/LANDSCAPE ARCHITECTS, MOUNT LAUREL, NEW JERSEY, DATED 08/12/92.
- 2.) APPROXIMATE LIMITS OF SLUDGE AREA TAKEN FROM THE FOCUSED FEASIBILITY STUDY INVESTIGATION REPORT (GOLDER, 1997).



REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	REV
PROJECT: 216 PATERSON PLANK ROAD SITE PRELIMINARY (35%) DESIGN REPORT FOR OU-2 CARLSTADT, BERGEN COUNTY, NEW JERSEY						
TITLE: GRADING AND SURFACE WATER MANAGEMENT PLAN						
PROJECT No. 943-5222			FILE No. 9436222-002			
DESIGN	VEF	12/06/05	SCALE	AS SHOWN	REV.	C
CADD	RG	12/06/05				
CHECK	CDH	12/16/05				
REVIEW	AA	PM	12/16/05	FIGURE 4		



CL-3

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 0

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3206	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999975000E-04	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.20	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1257	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	3.29999995000	CM/SEC
SLOPE	=	3.00	PERCENT
DRAINAGE LENGTH	=	180.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER

MATERIAL TEXTURE NUMBER 36

THICKNESS	=	0.04	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.399999993000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3	- GOOD

LAYER 5

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 17

CL-3 (2)

THICKNESS	=	0.25	INCHES
POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08	CM/SEC

LAYER 6

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 7

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1898	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.520000001000E-03	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 4 WITH A
FAIR STAND OF GRASS, A SURFACE SLOPE OF 3.4
AND A SLOPE LENGTH OF 180. FEET.

SCS RUNOFF CURVE NUMBER	=	60.70	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	20.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	5.893	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.460	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.080	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	9.730	INCHES
TOTAL INITIAL WATER	=	9.730	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
NEWARK NEW JERSEY

STATION LATITUDE	=	40.70	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	

CL-3 (3)

START OF GROWING SEASON (JULIAN DATE) = 108
 END OF GROWING SEASON (JULIAN DATE) = 301
 EVAPORATIVE ZONE DEPTH = 20.0 INCHES
 AVERAGE ANNUAL WIND SPEED = 10.20 MPH
 AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 64.00 %
 AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 61.00 %
 AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 66.00 %
 AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 68.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
 COEFFICIENTS FOR NEWARK NEW JERSEY

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.13	3.05	4.15	3.57	3.59	2.94
3.85	4.30	3.66	3.09	3.59	3.42

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
 COEFFICIENTS FOR NEWARK NEW JERSEY

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
31.30	32.80	41.20	52.10	62.30	71.50
76.80	75.50	68.20	57.20	46.50	35.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
 COEFFICIENTS FOR NEWARK NEW JERSEY
 AND STATION LATITUDE = 40.70 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.91	3.48	4.30	2.94	4.28	2.73
	3.80	4.46	3.64	2.31	3.11	3.74
STD. DEVIATIONS	1.32	1.39	2.19	1.26	2.36	1.34

CL-3(4)

	1.81	2.19	1.78	1.10	1.36	1.49
RUNOFF						

TOTALS	1.030	1.509	1.402	0.000	0.006	0.003
	0.000	0.028	0.035	0.000	0.002	0.020
STD. DEVIATIONS	1.329	0.913	1.946	0.001	0.021	0.014
	0.000	0.126	0.151	0.001	0.008	0.070
EVAPOTRANSPIRATION						

TOTALS	0.859	0.762	1.980	2.445	3.284	4.914
	3.804	3.784	2.622	1.273	1.255	0.944
STD. DEVIATIONS	0.317	0.354	0.496	0.574	1.227	0.835
	1.482	1.473	0.813	0.345	0.243	0.164
LATERAL DRAINAGE COLLECTED FROM LAYER 3						

TOTALS	0.9806	0.5815	2.4018	1.0979	1.1442	0.4373
	0.1552	0.0527	0.1933	0.1850	0.8381	1.6265
STD. DEVIATIONS	0.6707	0.9964	1.0114	1.0858	1.0955	0.3881
	0.1142	0.0413	0.5236	0.3206	1.1280	1.3933
PERCOLATION/LEAKAGE THROUGH LAYER 5						

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6						

TOTALS	0.0030	0.0026	0.0027	0.0026	0.0025	0.0024
	0.0024	0.0021	0.0012	0.0007	0.0014	0.0018
STD. DEVIATIONS	0.0043	0.0035	0.0036	0.0032	0.0030	0.0027
	0.0026	0.0021	0.0014	0.0013	0.0023	0.0022

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)						

DAILY AVERAGE HEAD ON TOP OF LAYER 4						

AVERAGES	0.0232	0.0847	0.1644	0.0231	0.0433	0.0047
	0.0016	0.0005	0.0032	0.0019	0.0663	0.0505
STD. DEVIATIONS	0.0613	0.2877	0.1587	0.0401	0.0800	0.0042
	0.0012	0.0004	0.0101	0.0033	0.2275	0.0894

CL-3(5)

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	41.70 (6.518)		151374.6	100.00
RUNOFF	4.036 (2.8998)		14650.82	9.679
EVAPOTRANSPIRATION	27.926 (3.3941)		101369.85	66.966
LATERAL DRAINAGE COLLECTED FROM LAYER 3	9.69399 (2.95192)		35189.187	23.24642
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00001 (0.00001)		0.043	0.00003
AVERAGE HEAD ON TOP OF LAYER 4	0.039 (0.031)			
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.02535 (0.03035)		92.035	0.06080
CHANGE IN WATER STORAGE	0.020 (1.6154)		72.74	0.048

CC-3(6)

PEAK DAILY VALUES FOR YEARS 1 THROUGH 20		
	(INCHES)	(CU. FT.)
PRECIPITATION	4.02	14592.600
RUNOFF	3.039	11033.1777
DRAINAGE COLLECTED FROM LAYER 3	0.62420	2265.84521
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000009	0.03283
AVERAGE HEAD ON TOP OF LAYER 4	11.965	
MAXIMUM HEAD ON TOP OF LAYER 4	16.417	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	56.4 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000646	2.34580
SNOW WATER	4.38	15904.2266
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.4496
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.1040

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

CL-3(7)

FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.8916	0.3153
2	6.2689	0.3483
3	0.0127	0.0635
4	0.0000	0.0000
5	0.1875	0.7500
6	1.7705	0.1475
SNOW WATER	0.000	

CG3 (8)

CL-3a

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 4

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.1050	VOL/VOL
WILTING POINT	=	0.0470	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1958	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.170000002000E-02	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.20	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0896	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	3.29999995000	CM/SEC
SLOPE	=	3.00	PERCENT
DRAINAGE LENGTH	=	180.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER

MATERIAL TEXTURE NUMBER 36

THICKNESS	=	0.04	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.399999993000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3	- GOOD

LAYER 5

CL-32 (2)

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.25	INCHES
POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08	CM/SEC

LAYER 6

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 7

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1873	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.520000001000E-03	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 4 WITH A
FAIR STAND OF GRASS, A SURFACE SLOPE OF 3.3%
AND A SLOPE LENGTH OF 180. FEET.

SCS RUNOFF CURVE NUMBER	=	60.70	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	20.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.362	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	8.740	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.940	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	6.654	INCHES
TOTAL INITIAL WATER	=	6.654	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
NEWARK NEW JERSEY

CL-3 d(37)

STATION LATITUDE	=	40.70 DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	108
END OF GROWING SEASON (JULIAN DATE)	=	301
EVAPORATIVE ZONE DEPTH	=	20.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	10.20 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	64.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	61.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	66.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	68.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR NEWARK NEW JERSEY

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.13	3.05	4.15	3.57	3.59	2.94
3.85	4.30	3.66	3.09	3.59	3.42

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR NEWARK NEW JERSEY

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
31.30	32.80	41.20	52.10	62.30	71.50
76.80	75.50	68.20	57.20	46.50	35.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR NEWARK NEW JERSEY
AND STATION LATITUDE = 40.70 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.91	3.48	4.30	2.94	4.28	2.73
	3.80	4.46	3.64	2.31	3.11	3.74

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STD. DEVIATIONS	1.32	1.39	2.19	1.26	2.36	1.34
	1.81	2.19	1.78	1.10	1.36	1.49
RUNOFF						

TOTALS	0.814	1.231	1.228	0.000	0.000	0.000
	0.000	0.003	0.001	0.000	0.000	0.010
STD. DEVIATIONS	1.114	0.807	1.797	0.000	0.001	0.000
	0.000	0.016	0.004	0.000	0.000	0.036
EVAPOTRANSPIRATION						

TOTALS	0.879	0.762	1.989	2.444	3.286	4.011
	3.374	3.677	2.553	1.407	1.395	1.018
STD. DEVIATIONS	0.327	0.361	0.500	0.607	1.254	1.183
	1.470	1.485	0.836	0.417	0.224	0.167
LATERAL DRAINAGE COLLECTED FROM LAYER 3						

TOTALS	0.8975	0.6842	3.1040	0.9262	1.1650	0.4445
	0.2010	0.3381	0.4876	0.4394	1.0768	1.8079
STD. DEVIATIONS	0.8201	1.2161	1.2830	1.0352	1.1544	0.3843
	0.1900	0.5314	0.7186	0.4683	1.0491	1.3914
PERCOLATION/LEAKAGE THROUGH LAYER 5						

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6						

TOTALS	0.0026	0.0022	0.0023	0.0022	0.0022	0.0021
	0.0021	0.0020	0.0019	0.0019	0.0018	0.0018
STD. DEVIATIONS	0.0036	0.0030	0.0031	0.0028	0.0027	0.0024
	0.0024	0.0022	0.0020	0.0020	0.0018	0.0018

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)						

DAILY AVERAGE HEAD ON TOP OF LAYER 4						

AVERAGES	0.0438	0.1269	0.5234	0.0384	0.0588	0.0061
	0.0021	0.0157	0.0212	0.0066	0.0592	0.0676
STD. DEVIATIONS	0.1567	0.3313	0.4610	0.0675	0.0986	0.0095
	0.0020	0.0433	0.0568	0.0100	0.1761	0.1001

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.70 (6.518)	151374.6	100.00
RUNOFF	3.287 (2.6257)	11931.36	7.882
EVAPOTRANSPIRATION	26.796 (3.4321)	97268.52	64.257
LATERAL DRAINAGE COLLECTED FROM LAYER 3	11.57229 (3.11844)	42007.418	27.75064
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00002 (0.00001)	0.080	0.00005
AVERAGE HEAD ON TOP OF LAYER 4	0.081 (0.045)		
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.02491 (0.02971)	90.439	0.05974
CHANGE IN WATER STORAGE	0.021 (1.6445)	76.89	0.051

CL-32(6)

PEAK DAILY VALUES FOR YEARS 1 THROUGH 20		
	(INCHES)	(CU. FT.)
PRECIPITATION	4.02	14592.600
RUNOFF	2.822	10244.4785
DRAINAGE COLLECTED FROM LAYER 3	0.64587	2344.51807
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000011	0.04028
AVERAGE HEAD ON TOP OF LAYER 4	13.929	
MAXIMUM HEAD ON TOP OF LAYER 4	18.561	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	60.1 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000543	1.97079
SNOW WATER	4.38	15904.2266
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.3909
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.0470

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.0570	0.1762
2	3.9143	0.2175
3	0.1700	0.8500
4	0.0000	0.0000
5	0.1875	0.7500
6	1.7492	0.1458
SNOW WATER	0.000	

CL-32(8)

CL-10

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 0

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.3236	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.999999975000E-04	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.20	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0350	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	3.29999995000	CM/SEC
SLOPE	=	10.00	PERCENT
DRAINAGE LENGTH	=	120.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER

MATERIAL TEXTURE NUMBER 36

THICKNESS	=	0.04	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.399999993000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3	- GOOD

LAYER 5

TYPE 3 - BARRIER SOIL LINER

MATERIAL TEXTURE NUMBER 17

CL-10(2)

THICKNESS	=	0.25	INCHES
POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08	CM/SEC

LAYER 6

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 7

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1875	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.520000001000E-03	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 4 WITH A
FAIR STAND OF GRASS, A SURFACE SLOPE OF 10.4
AND A SLOPE LENGTH OF 120. FEET.

SCS RUNOFF CURVE NUMBER	=	63.50	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	20.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	5.975	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	9.460	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	2.080	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	9.782	INCHES
TOTAL INITIAL WATER	=	9.782	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
NEWARK NEW JERSEY

STATION LATITUDE	=	40.70	DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00	

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START OF GROWING SEASON (JULIAN DATE) = 108
 END OF GROWING SEASON (JULIAN DATE) = 301
 EVAPORATIVE ZONE DEPTH = 20.0 INCHES
 AVERAGE ANNUAL WIND SPEED = 10.20 MPH
 AVERAGE 1ST QUARTER RELATIVE HUMIDITY = 64.00 %
 AVERAGE 2ND QUARTER RELATIVE HUMIDITY = 61.00 %
 AVERAGE 3RD QUARTER RELATIVE HUMIDITY = 66.00 %
 AVERAGE 4TH QUARTER RELATIVE HUMIDITY = 68.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
 COEFFICIENTS FOR NEWARK NEW JERSEY

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.13	3.05	4.15	3.57	3.59	2.94
3.85	4.30	3.66	3.09	3.59	3.42

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
 COEFFICIENTS FOR NEWARK NEW JERSEY

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
31.30	32.80	41.20	52.10	62.30	71.50
76.80	75.50	68.20	57.20	46.50	35.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
 COEFFICIENTS FOR NEWARK NEW JERSEY
 AND STATION LATITUDE = 40.70 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.91	3.48	4.30	2.94	4.28	2.73
	3.80	4.46	3.64	2.31	3.11	3.74
STD. DEVIATIONS	1.32	1.39	2.19	1.26	2.36	1.34

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	1.81	2.19	1.78	1.10	1.36	1.49
RUNOFF						

TOTALS	1.039	1.513	1.412	0.001	0.016	0.001
	0.000	0.023	0.029	0.000	0.012	0.021
STD. DEVIATIONS	1.338	0.918	1.954	0.004	0.046	0.003
	0.001	0.103	0.117	0.000	0.052	0.073
EVAPOTRANSPIRATION						

TOTALS	0.870	0.751	1.960	2.446	3.252	4.934
	3.666	3.630	2.530	1.276	1.278	0.962
STD. DEVIATIONS	0.313	0.345	0.489	0.605	1.232	0.820
	1.509	1.491	0.837	0.360	0.245	0.169
LATERAL DRAINAGE COLLECTED FROM LAYER 3						

TOTALS	0.9567	0.5714	2.3815	1.1124	1.1300	0.4621
	0.2567	0.1922	0.3292	0.2651	0.8034	1.5748
STD. DEVIATIONS	0.6954	0.9956	0.9943	1.0729	1.0542	0.4451
	0.1478	0.0639	0.4860	0.2849	1.0439	1.3891
PERCOLATION/LEAKAGE THROUGH LAYER 5						

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6						

TOTALS	0.0026	0.0022	0.0023	0.0022	0.0022	0.0021
	0.0021	0.0020	0.0019	0.0019	0.0017	0.0018
STD. DEVIATIONS	0.0037	0.0030	0.0030	0.0028	0.0027	0.0025
	0.0024	0.0023	0.0021	0.0019	0.0017	0.0019

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)						

DAILY AVERAGE HEAD ON TOP OF LAYER 4						

AVERAGES	0.0020	0.0013	0.0050	0.0024	0.0024	0.0010
	0.0005	0.0004	0.0007	0.0006	0.0017	0.0033
STD. DEVIATIONS	0.0015	0.0022	0.0021	0.0023	0.0022	0.0010
	0.0003	0.0001	0.0010	0.0006	0.0023	0.0029

CL-10(5)

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES	CU. FEET	PERCENT
PRECIPITATION	41.70 (6.518)	151374.6	100.00
RUNOFF	4.066 (2.9150)	14761.20	9.751
EVAPOTRANSPIRATION	27.555 (3.4539)	100025.20	66.078
LATERAL DRAINAGE COLLECTED FROM LAYER 3	10.03552 (2.71172)	36428.945	24.06543
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00000 (0.00000)	0.018	0.00001
AVERAGE HEAD ON TOP OF LAYER 4	0.002 (0.000)		
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.02502 (0.02981)	90.819	0.06000
CHANGE IN WATER STORAGE	0.019 (1.6708)	68.45	0.045

CU-10(6)

PEAK DAILY VALUES FOR YEARS 1 THROUGH 20		
	(INCHES)	(CU. FT.)
PRECIPITATION	4.02	14592.600
RUNOFF	3.049	11067.6201
DRAINAGE COLLECTED FROM LAYER 3	1.31478	4772.64795
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000000	0.00016
AVERAGE HEAD ON TOP OF LAYER 4	0.085	
MAXIMUM HEAD ON TOP OF LAYER 4	0.169	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	0.0 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000552	2.00234
SNOW WATER	4.38	15904.2266
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.4501
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.1040

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.9832	0.3305
2	6.2370	0.3465
3	0.0022	0.0109
4	0.0000	0.0000
5	0.1875	0.7500
6	1.7495	0.1458
SNOW WATER	0.000	

CL-10(8)

CL-10a

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER

MATERIAL TEXTURE NUMBER 4

THICKNESS	=	18.00	INCHES
POROSITY	=	0.4370	VOL/VOL
FIELD CAPACITY	=	0.1050	VOL/VOL
WILTING POINT	=	0.0470	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1978	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.170000002000E-02	CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER

MATERIAL TEXTURE NUMBER 0

THICKNESS	=	0.25	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0234	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	3.29999995000	CM/SEC
SLOPE	=	10.00	PERCENT
DRAINAGE LENGTH	=	120.0	FEET

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER

MATERIAL TEXTURE NUMBER 36

THICKNESS	=	0.04	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.399999993000E-12	CM/SEC
FML PINHOLE DENSITY	=	1.00	HOLES/ACRE
FML INSTALLATION DEFECTS	=	2.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3	GOOD

LAYER 5

CL-102(2)

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 17

THICKNESS	=	0.25	INCHES
POROSITY	=	0.7500	VOL/VOL
FIELD CAPACITY	=	0.7470	VOL/VOL
WILTING POINT	=	0.4000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.7500	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.300000003000E-08	CM/SEC

LAYER 6

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 7

THICKNESS	=	12.00	INCHES
POROSITY	=	0.4730	VOL/VOL
FIELD CAPACITY	=	0.2220	VOL/VOL
WILTING POINT	=	0.1040	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.1877	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.520000001000E-03	CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
SOIL DATA BASE USING SOIL TEXTURE # 4 WITH A
FAIR STAND OF GRASS, A SURFACE SLOPE OF 10. %
AND A SLOPE LENGTH OF 120. FEET.

SCS RUNOFF CURVE NUMBER	=	63.50	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	1.000	ACRES
EVAPORATIVE ZONE DEPTH	=	20.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	3.407	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	8.740	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.940	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	6.702	INCHES
TOTAL INITIAL WATER	=	6.702	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
NEWARK NEW JERSEY

CL-102(3)

STATION LATITUDE	=	40.70 DEGREES
MAXIMUM LEAF AREA INDEX	=	2.00
START OF GROWING SEASON (JULIAN DATE)	=	108
END OF GROWING SEASON (JULIAN DATE)	=	301
EVAPORATIVE ZONE DEPTH	=	20.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	10.20 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	64.00 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	61.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	66.00 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	68.00 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR NEWARK NEW JERSEY

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.13	3.05	4.15	3.57	3.59	2.94
3.85	4.30	3.66	3.09	3.59	3.42

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR NEWARK NEW JERSEY

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
31.30	32.80	41.20	52.10	62.30	71.50
76.80	75.50	68.20	57.20	46.50	35.50

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR NEWARK NEW JERSEY
AND STATION LATITUDE = 40.70 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	2.91	3.48	4.30	2.94	4.28	2.73
	3.80	4.46	3.64	2.31	3.11	3.74

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STD. DEVIATIONS	1.32	1.39	2.19	1.26	2.36	1.34
	1.81	2.19	1.78	1.10	1.36	1.49
RUNOFF						

TOTALS	0.823	1.239	1.238	0.000	0.001	0.000
	0.000	0.008	0.003	0.000	0.000	0.010
STD. DEVIATIONS	1.122	0.806	1.810	0.000	0.005	0.000
	0.000	0.035	0.012	0.000	0.000	0.038
EVAPOTRANSPIRATION						

TOTALS	0.862	0.763	1.912	2.417	3.263	3.970
	2.808	3.181	2.235	1.385	1.313	0.951
STD. DEVIATIONS	0.323	0.352	0.472	0.565	1.228	1.219
	1.398	1.527	0.871	0.431	0.261	0.169
LATERAL DRAINAGE COLLECTED FROM LAYER 3						

TOTALS	0.8867	0.6722	3.0338	0.9881	1.2206	0.5368
	0.7792	0.8615	0.8434	0.6041	1.1554	1.6832
STD. DEVIATIONS	0.7849	1.1832	1.2192	1.1066	1.1880	0.3833
	0.2587	0.4212	0.6025	0.2880	0.9417	1.4175
PERCOLATION/LEAKAGE THROUGH LAYER 5						

TOTALS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
STD. DEVIATIONS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PERCOLATION/LEAKAGE THROUGH LAYER 6						

TOTALS	0.0026	0.0022	0.0024	0.0022	0.0022	0.0021
	0.0021	0.0020	0.0019	0.0019	0.0018	0.0018
STD. DEVIATIONS	0.0037	0.0031	0.0032	0.0028	0.0026	0.0025
	0.0024	0.0023	0.0020	0.0020	0.0019	0.0019

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4

AVERAGES	0.0033	0.0041	0.0284	0.0021	0.0026	0.0012
	0.0016	0.0018	0.0018	0.0013	0.0025	0.0035
STD. DEVIATIONS	0.0076	0.0090	0.0315	0.0024	0.0025	0.0008
	0.0005	0.0009	0.0013	0.0006	0.0020	0.0030

CL-102 (5)

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	41.70	(6.518)	151374.6	100.00
RUNOFF	3.323	(2.6379)	12062.24	7.968
EVAPOTRANSPIRATION	25.062	(3.2826)	90975.29	60.099
LATERAL DRAINAGE COLLECTED FROM LAYER 3	13.26508	(3.03474)	48152.242	31.80998
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.00001	(0.00000)	0.020	0.00001
AVERAGE HEAD ON TOP OF LAYER 4	0.005	(0.003)		
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.02521	(0.03032)	91.521	0.06046
CHANGE IN WATER STORAGE	0.026	(1.7191)	93.35	0.062

CL-102(6)

PEAK DAILY VALUES FOR YEARS 1 THROUGH 20		
	(INCHES)	(CU. FT.)
PRECIPITATION	4.02	14592.600
RUNOFF	2.829	10269.1016
DRAINAGE COLLECTED FROM LAYER 3	2.78446	10107.59860
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.000003	0.00916
AVERAGE HEAD ON TOP OF LAYER 4	3.918	
MAXIMUM HEAD ON TOP OF LAYER 4	5.087	
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	10.1 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 6	0.000561	2.03495
SNOW WATER	4.38	15904.2266
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.3915
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.0470

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

CL-102(77)

FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	1.0991	0.1832
2	4.1740	0.2319
3	0.0074	0.0296
4	0.0000	0.0000
5	0.1875	0.7500
6	1.7485	0.1457
SNOW WATER	0.000	

**GOLDER
ASSOCIATES**

Subject: SOIL LOSS CALCULATION – MIN & MAX SLOPES

Job No: 943-6222

Made by: VEF

Date: 11/03/05

Ref: Carlstadt

Checked by: MFM

Revised: 10/25/06

Reviewed by: MFM

Sheet: 1 of 7

OBJECTIVE: To estimate the actual soil loss that can be anticipated for the proposed final cover grading plan for the expected good stand of grass.

METHOD: Per Reference 3, use the Universal Soil Loss Equation (USLE) to estimate the soil loss.

REFERENCES:

- 1) McCuen, Richard H., "Hydrologic Analysis and Design," 1989, pp. 707 - 715.
- 2) Figure entitled, "Grading and Surface Water Management Plan," prepared by Golder Associates, dated 11/10/05.
- 3) USEPA, "Evaluating Cover Systems for Solid and Hazardous Waste," dated September 2002.

ASSUMPTIONS:

- 1) Critical steep slope: 240 feet at 2.5%.
- 2) Natural soils in the area are fine sandy loams. A minimum organic content of 2% has been assumed for this evaluation.

CALCULATIONS: 1) $USLE\ is\ A = R\ K\ (LS)\ C\ P$

Where,

A = average annual soil loss, tons/acre/year

R = rainfall and runoff erosivity index

K = soil erodibility factor, tons/acre

L = slope-length factor

S = slope-steepness factor

C = cover management practice

P = crop practice factor

Such that,

A = sought value

R = 195 (Ref. 1, Figure 15-2)

K = 0.30 (Ref. 3, Table 5, fine sandy loam, k = 2%)

C = 0.004 (Ref. 1, Table 15-4, meadow – grass & legume mix)

P = 1.0 (Ref. 1, Table 15-5, no support practice)

For critical slope (240 ft, 2.5% slope), $LS = 0.32$ (Table 15-3).
Plugging in the values,

$$A = (195)(0.32)(1.09)(0.004)(1.0) = 0.075 \text{ tons/acre/year}$$

CONCLUSION: The maximum computed average annual soil loss for the critical slope is 0.075 tons/acre/year, which is less than the federally maximum allowable value of 2 tons/acre/yr. Assuming a unit weight of 120 pounds per cubic feet for the soil, the erosion is 0.000029 ft/year.

Sheet 2 of 7

LEGEND

- S — EXISTING GROUND CONTOURS
- — — — — EDGE OF STREAM
- x - x - x - EXISTING FENCE
- — — — — PROPERTY LINE
- - - - - EXISTING SHEET PILE WALL (TO BE PARTIALLY REMOVED)
- - - - - NEW SHEET PILE WALL (SEE FIGURES 13 AND 14)
- WEIR (SEE NOTE 5)
- X EL 2.5 SPOT ELEVATION
- — — — — LIMITS OF NEW GEOMEMBRANE (SEE NOTE 3)
- 13 — PROPOSED GROUND CONTOURS
- — — — — PERIMETER DRAINAGE CHANNEL (SEE DETAILS 2/5 AND 4/5)
- — — — — NEW PERIMETER ACCESS ROAD AND PARKING AREAS (SEE DETAILS 3/5 AND 5/5)

NOTES

- 1.) ALL LOCATIONS ARE APPROXIMATE.
- 2.) CONTRACTOR MAY ELECT TO REMOVE PORTIONS OF THE PERIMETER FENCE DURING CONSTRUCTION TO ACCOMMODATE ITS ACTIVITIES. IN THAT EVENT, CONTRACTOR SHALL PROVIDE TEMPORARY ACCESS RESTRICTIONS IN AREAS WHERE THE EXISTING FENCE IS REMOVED, AND SHALL RESTORE FENCE TO ORIGINAL CONDITION, OR BETTER, UPON COMPLETION OF CONSTRUCTION.
- 3.) LIMITS OF THE NEW GEOMEMBRANE SHALL COINCIDE WITH THE LIMITS OF THE EXISTING GEOMEMBRANE.
- 4.) CONTRACTOR SHALL PROTECT ALL STRUCTURES, FENCELINES, WELLS, AND OTHER SITE FEATURES DURING CONSTRUCTION, UNLESS INDICATED OTHERWISE ON THESE DRAWINGS, OR AS DIRECTED BY THE GROUP'S REPRESENTATIVE. THE CONTRACTOR SHALL REPLACE ANY DAMAGED ITEMS AT ITS SOLE EXPENSE.
- 5.) SURFACE WATER FLOWS SHALL BE CONVEYED TO PEACH ISLAND CREEK VIA THE PERIMETER DRAINAGE CHANNELS, AND DISCHARGE TO CREEK THROUGH A SERIES OF WEIRS IN THE TOPS OF THE NEW SHEET PILE WALLS.

REFERENCES

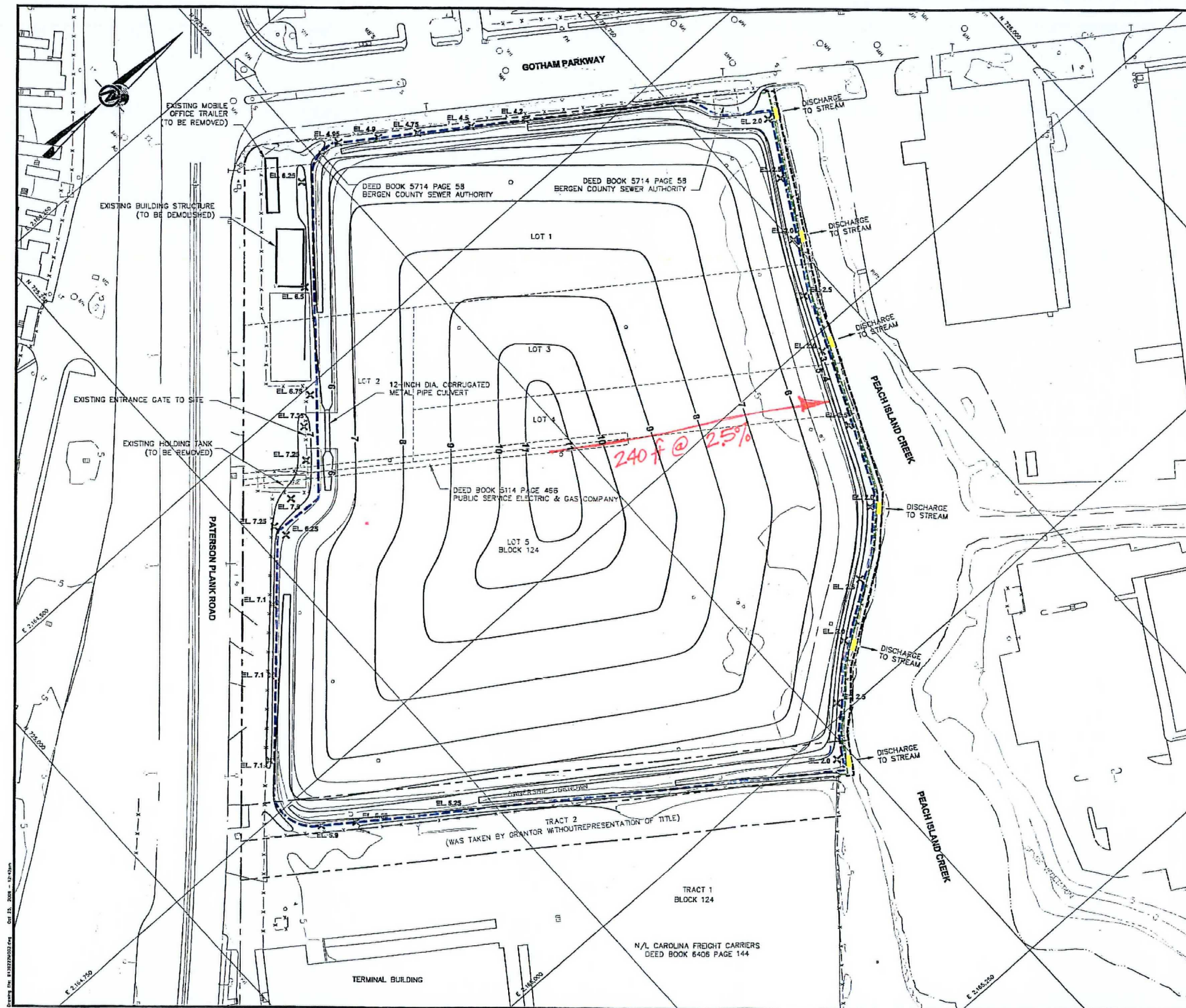
- 1.) BASE MAP SHOWN TAKEN FROM DIGITAL FILE 3074-02-TOPO.DWG, ENTITLED "BOROUGH OF CARLSTADT BLOCK 124 LOTS 1 THROUGH 5," DATED DECEMBER 8, 2005, PREPARED BY PROMAPS.
- 2.) HORIZONTAL DATUM REFERENCES THE NEW JERSEY STATE PLANE COORDINATE SYSTEM, NORTH AMERICAN DATUM OF 1983 (NAD 83). VERTICAL DATUM REFERENCES THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).



REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
PROJECT						
216 PATERSON PLANK ROAD SITE PRE-FINAL (95%) DESIGN REPORT FOR OU-2 CARLSTADT, BERGEN COUNTY, NEW JERSEY						
TITLE						
GRADING AND DRAINAGE PLAN						
PROJECT No. 943-6222 FILE No. 9436222M002						
DESIGN	VEF	10/10/06	SCALE	AS SHOWN	REV.	0
CADD	RG	10/10/06				
CHECK						
REVIEW						



FIGURE 4



Drawing File: 9436222M002.dwg
Crd 15, 2006 - 12:07pm

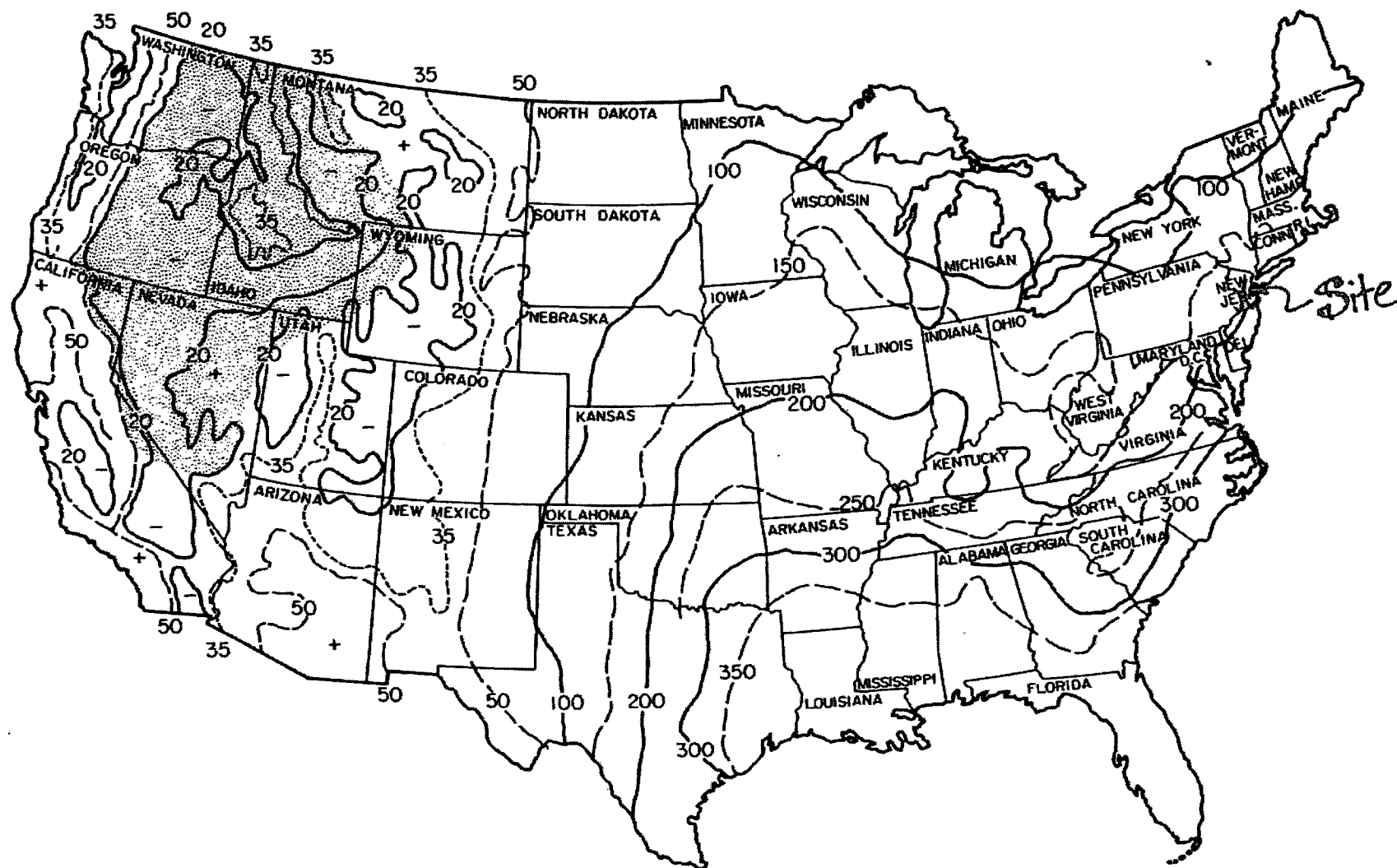


Fig. 15-2 Average annual values of the rainfall-erosivity factor, R .

soil in a unit plot, pinpoints differences in erosion according to differences in soil type. Long-term plot studies under natural rainfall have produced K values generalized in Table 5 for the USDA soil types.

TABLE 5. APPROXIMATE VALUES OF FACTOR K FOR
USDA TEXTURAL CLASSES¹¹

Texture class	Organic matter content		
	<0.5%	2%	4%
	K	K	K
Sand	0.05	0.03	0.02
Fine sand	.16	.14	.10
Very fine sand	.42	.36	.28
Loamy sand	.12	.10	.08
Loamy fine sand	.24	.20	.16
Loamy very fine sand	.44	.38	.30
Sandy loam	.27	.24	.19
Fine sandy loam	.35	.30	.24
Very fine sandy loam	.47	.41	.33
Loam	.38	.34	.29
Silt loam	.48	.42	.33
Silt	.60	.52	.42
Sandy clay loam	.27	.25	.21
Clay loam	.28	.25	.21
Silty clay loam	.37	.32	.26
Sandy clay	.14	.13	.12
Silty clay	.25	.23	.19
Clay	0.13-0.29		

The values shown are estimated averages of broad ranges of specific-soil values. When a texture is near the borderline of two texture classes, use the average of the two K values.

The evaluator must next consider the shape of the slope in terms of length and inclination. The appropriate LS factor is obtained from Table 6. A nonlinear slope may have to be evaluated as a series of segments, each with uniform gradient. Two or three segments should be sufficient for most engineered landfills; provided the segments are selected so that they are also of equal length (Table 6 can be used, with certain adjustments). Enter Table 6 with the total slope length and read LS values corresponding to the percent slope of each segment. For three segments, multiply the chart LS values for the upper, middle, and lower segments by 0.58, 1.06, and 1.37, respectively. The average of the three products is a good estimate of the

TABLE 15-4 Generalized values of the cover and management factor, C, in the 37 states east of the Rocky Mountains^a

Line no. Crop, Rotation, and Management ^{c,d}		Productivity Level ^b	
		High	Mod.
		C Value	
Base value: continuous fallow, tilled up and down slope		1.00	1.00
CORN			
1	C, RdR, fall TP, conv (1)	0.54	0.62
2	C, RdR, spring TP, conv (1)	0.50	0.59
3	C, RdL, fall TP, conv (1)	0.42	0.52
4	C, RdR, wc seeding, spring TP, conv (1)	0.40	0.49
5	C, RdL, standing, spring TP, conv (1)	0.38	0.48
6	C, fall shred stalks, spring TP, conv (1)	0.35	0.44
7	C(silage)-W(RdL, fall TP) (2)	0.31	0.35
8	C, RdL, fall chisel, spring disk, 40-30% rc (1)	0.24	0.30
9	C(silage), W wc seeding, no-till pl in c-k W (1)	0.20	0.24
10	C(RdL)-W(RdL, spring TP) (2)	0.20	0.28
11	C, fall shred stalks, chisel pl, 40-30% rc (1)	0.19	0.26
12	C-C-C-W-M, RdL, TP for C, disk for W (5)	0.17	0.23
13	C, RdL, strip till row zones, 55-40% rc (1)	0.16	0.24
14	C-C-C-W-M-M, RdL, TP for C, disk for W (6)	0.14	0.20
15	C-C-W-M, RdL, TP for C, disk for W (4)	0.12	0.17
16	C, fall shred, no-till pl, 70-50% rc (1)	0.11	0.18
17	C-C-W-M-M, RdL, TP for C, disk for W (5)	0.087	0.14
18	C-C-C-W-M, RdL, no-till pl 2d & 3rd C (5)	0.076	0.13
19	C-C-W-M, RdL, no-till pl 2d C (4)	0.068	0.11
20	C, no-till pl in c-k wheat, 90-70% rc (1)	0.062	0.14
21	C-C-C-W-M-M, no-till pl 2d & 3rd C (6)	0.061	0.11
22	C-W-M, RdL, TP for C, disk for W (3)	0.055	0.095
23	C-C-W-M-M, RdL, no-till pl 2d C (5)	0.051	0.094
24	C-W-M-M, RdL, TP for C, disk for W (4)	0.039	0.074
25	C-W-M-M-M, RdL, TP for C, disk for W (5)	0.032	0.061
26	C, no-till pl in c-k sod, 95-80% rc (1)	0.017	0.053
COTTON ^e			
27	Cot, conv (Western Plains) (1)	0.42	0.49
28	Cot, conv (South) (1)	0.34	0.40
MEADOW			
29	Grass and legume mix	0.004	0.01
30	Alfalfa, lespedeza, or Sericia	0.020	
31	Sweet clover	0.025	
SORGHUM, GRAIN (Western Plains) ^e			
32	RdL, spring TP, conv (1)	0.43	0.53
33	No-till pl in shredded 70-50% rc	0.11	0.18

(Continued)

TABLE 15-5 Values of support-practice factor, P

Practice	Land Slope (%)				
	1.1-2	2.1-7	7.1-12	12.1-18	18.1-24
	Factor P				
Contouring, P_c	0.60	0.50	0.60	0.80	0.90
Contour strip cropping, ^a P_{sc}					
R-R-M-M	0.30	0.25	0.30	0.40	0.45
R-W-M-M	0.30	0.25	0.30	0.40	0.45
R-R-W-M	0.45	0.38	0.45	0.60	0.68
R-W	0.52	0.44	0.52	0.70	0.90
R-O	0.60	0.50	0.60	0.80	0.90
Contour listing or ridge planting, P_{cl}	0.30	0.25	0.30	0.40	0.45
Contour terracing, ^{b,c} P_t	$0.6/\sqrt{n}$	$0.5/\sqrt{n}$	$0.6/\sqrt{n}$	$0.8/\sqrt{n}$	$0.9/\sqrt{n}$
No support practice	1.0	1.0	1.0	1.0	1.0

^a R, rowcrop; W, fall-seeded grain; O, spring-seeded grain; M, meadow. The crops are grown in rotation and so arranged on the field that rowcrop strips are always separated by a meadow or winter-grain strip.

^b These P_t values estimate the amount of soil eroded to the terrace channels and are used for conservation planning. For prediction of off-field sediment, the P_t values are multiplied by 0.2.

^c n , number of approximately equal-length intervals into which the field slope is divided by the terraces. Tillage operations must be parallel to the terraces.

Predicted values of E represent average, time-invariant estimates. Given that R is based on an average number and distribution of storms per year, actual values of E would vary from year to year depending on the number, size, and timing of erosive rainstorms and other weather conditions. Although any one predicted value of E may not be highly accurate, the USLE should be more reliable when it is used to measure either relative effects or long-term sheet and rill erosion rates.

Example 15-1: Soil Loss Estimation with USLE. The general data requirements for making soil loss estimates with the USLE equation are (1) site location (to get R); (2) soil properties (to get K); (3) flow length and slope (to get T); (4) crop, rotation, and management practices (to get C); and (5) slope and support practice (to get P). The estimation process will be illustrated using a hypothetical example. The site, which has a drainage area of 2 acres, is located in central Illinois. The site of interest has an average slope of 2.5% and a flow length of 300 ft. A soil analysis indicates 25% sand, 2% organic matter, 35% silt and very fine sand, a medium granular structure, and moderate permeability. The plot is used for corn, with a crop management value of 0.31, which was determined from information published locally. No support practice is provided.

TABLE 15-3 Values of the erosion equation's topographic factor, LS, for specified combinations of slope length and steepness*

Percent Slope	Slope Length (ft)											
	25	50	75	100	150	200	300	400	500	600	800	1000
0.5	0.07	0.08	0.09	0.10	0.11	0.12	0.14	0.15	0.16	0.17	0.19	0.20
1	0.09	0.10	0.12	0.13	0.15	0.16	0.18	0.20	0.21	0.22	0.24	0.26
2	0.13	0.16	0.19	0.20	0.23	0.25	0.28	0.31	0.33	0.34	0.38	0.40
3	0.19	0.23	0.26	0.29	0.33	0.35	0.40	0.44	0.47	0.49	0.54	0.57
4	0.23	0.30	0.36	0.40	0.47	0.53	0.62	0.70	0.76	0.82	0.92	1.0
5	0.27	0.38	0.46	0.54	0.66	0.76	0.93	1.1	1.2	1.3	1.5	1.7
6	0.34	0.48	0.58	0.67	0.82	0.95	1.2	1.4	1.5	1.7	1.9	2.1
8	0.50	0.70	0.86	0.99	1.2	1.4	1.7	2.0	2.2	2.4	2.8	3.1
10	0.69	0.97	1.2	1.4	1.7	1.9	2.4	2.7	3.1	3.4	3.9	4.3
12	0.90	1.3	1.6	1.8	2.2	2.6	3.1	3.6	4.0	4.4	5.1	5.7
14	1.2	1.6	2.0	2.3	2.8	3.3	4.0	4.6	5.1	5.6	6.5	7.3
16	1.4	2.0	2.5	2.8	3.5	4.0	4.9	5.7	6.4	7.0	8.0	9.0
18	1.7	2.4	3.0	3.4	4.2	4.9	6.0	6.9	7.7	8.4	9.7	11.0
20	2.0	2.9	3.5	4.1	5.0	5.8	7.1	8.2	9.1	10.0	12.0	13.0
25	3.0	4.2	5.1	5.9	7.2	8.3	10.0	12.0	13.0	14.0	17.0	19.0
30	4.0	5.6	6.9	8.0	9.7	11.0	14.0	16.0	18.0	20.0	23.0	25.0
40	6.3	9.0	11.0	13.0	16.0	18.0	22.0	25.0	28.0	31.0	—	—
50	8.9	13.0	15.0	18.0	22.0	25.0	31.0	—	—	—	—	—
60	12.0	16.0	20.0	23.0	28.0	—	—	—	—	—	—	—

* Values given for slopes longer than 300 ft or steeper than 18% are extrapolations beyond the range of the research data, and therefore less certain than the others. Adjustments for irregularity of slope are available.

Sheet 7 of 7

APPENDIX F

STREAM BANK ENHANCEMENT DESIGN CALCULATIONS

Objective

The objective of this analysis is to investigate the feasibility of replacing the existing sheet pile wall along Peach Island Creek with a graded embankment slope. Peach Island Creek acts as a physical boundary to the north side of the Site, and potentially can impact on the proposed design solutions for the OU-2 remedy. In general the proposed OU-2 remedy must maintain the integrity and stability of the existing slurry wall. This stability analysis will address the feasibility of an embankment, and considering the following design aspects:

- Long-term slope, based on final site grades;
- Short-term slope stability during construction; and
- Physical design constraints (i.e. geometric) for the implementing a proposed embankment slope solution.

The following sections will describe the results of these analyses and draw conclusions with respect to the feasibility for construction of an embankment slope solution..

Methodology

Data collected from the OU-1 remedy "as built" drawings and available subsurface investigations were used to obtain the typical subsurface conditions and design parameters. These conditions and parameters were used as typical input design parameters for the slope stability analyses, and are summarized in Table 1.

Slope stability simulations were preformed using the Slide software program (Version 5.019, 2005) to determine the safety factors associated with circular slip surfaces. The circular slip surfaces were computed using the Simplified Bishop Method. Design slope configurations for these analyses included a 2 foot thick cap extending 2 feet below the Peach Island Creek water surface and a 200 lb/ft² uniformly distributed surcharge load was place along the top of the cap. The surcharge load was included to emulate loads that may be present following the development of the property. The slope stability analyses were performed for final slope configurations including a cap and for grades at 3H:1V and 4H:1V. See Figures 1 and 2 for stability analysis results.

Table 1. Design parameters used in slope stability analyses.

Unit	Assumed Thickness (ft)	SPT N Value	Friction Angle (degrees)	Cohesion (lb/ft ²)	Saturated Unit Weight (lb/ft ³)
Cap	2	---	30	0	120
Fill	5	9	30	0	120
Peat	3.5	---	0	200	80
Grey Silt	3.5	3 - 16	0	400	110
Varved Clay	7	2 - 6	20	400	110
Slurry Wall	13 x 4 (depth x width)	---	10	0	100

A construction phase (i.e. short-term) slope stability analysis was conducted using the same methodologies as the design slope analysis. A typical cross section was adapted to exclude the cap layer, a 2H:1V slope and a forced slip surface projected through the toe of the fill slope. During the construction phase the upper portion of existing sheet pile wall extending down to the mud line (approximately 2 feet below the water surface) of the creek will be removed to facilitate the placement of the design slope.

Removal of the upper portion of the sheet pile wall will require temporary 2H:1V slope grades running from the slurry wall to creek. The lower portion of the sheet pile wall remaining in the subsurface will essentially start at the toe of the fill and extend downward, preventing soil slip surfaces extending through the sheet pile wall and forcing the critical failure surface to pass through the toe of the fill. A 200 lb/ft² surcharge load was placed inward from the soil bentonite slurry wall to emulate the loads from constriction equipment present during this phase. See Figure 3 for the short-term stability analysis results.

Available boring logs recorded along the northern property boundary were used to construct four (4) sections through the existing slurry and sheet pile walls. See Figure 4 cross section locations. For each cross section the design slope cap layer was superimposed over the existing profile to examine physical constraints for the placement of the design slope. See Figures 5 through 8 for each cross section.

Findings

The slope stability profiles and safety factors for the 3H:1V and 4H:1V graded slopes are presented graphically in Figures 1 and 2. Each of the figures shows a contour of safety factors based on a grid search in which the minimum calculated safety factor is displayed for the center of each circular slip surface. Safety factors related to the contour are provided in the legend and the critical slip surfaces are displayed and labeled.

The results of the 3H:1V slope stability analysis shows a global minimum safety factor of 1.36 extending through the cap, fill peat and slurry wall surfaces. Acceptable minimal safety factor values should equal at least 1.5 for long-term loading conditions (USACE, 2003). Based on the global minimum safety factor slip surface, a potential exists in which the existing slurry wall might be compromised. Therefore a 3H:1V slope design is not recommended, and reduction in the slope grade is required increase safety factor closer to 1.5. See Figure 1.

The slope stability analysis for the 4H:1V slope show an improved safety factor of 1.49 which approaches the desired minimal safety factor for long-term loading conditions. Therefore a 4H:1V slope or lower grade will suffice as a final design slope. See Figure 2.

The short-term construction phase stability analysis resulted in a global minimum safety factor of 1.09. Typical minimal acceptable safety factors for end of construction and multiphase loading should equal at least 1.3 (USACE, 2003). Under this scenario there is a risk that the existing slurry wall might be compromised. In order to overcome the possible slope failures during this construction phase, Golder recommends additional lateral support be provided to the existing slurry wall to ensure the stability/integrity of this slurry wall. Possible solutions could include installing a temporary sheet pile wall or soldier pile and lagged wall between the existing slurry and sheet pile walls.

Based on these slope stability analyses, Golder recommends that minimum design slope inclinations be equal or flatter than 4:1 (H:V).

To evaluate the possibility of constructing the proposed 4H:1V embankment slope, Golder considered the physical constraints due to Site grades and the existing slurry and sheet pile wall locations. Figure 4

provides the locations of four (4) cross sections, and Figures 5 through 8 show the final configuration of the cap superimposed on each cross section.

All four (4) cross sections show that a 4H:1V design slope beginning at the creek-side edge of the bentonite slurry wall will extend into the creek. In particular, the cross section at boring RD-1 (Figure 5) indicates that the proposed slope will encroach on the creek approximately 2 feet into the creek. However, the cross section at RD-3 (Figure 7) indicates the proposed slope will encroach at least extending nearly 20 ft into the creek.

Conclusions

Given the above findings, it appears significant stream encroachment issues will occur, if 4H:1V embankment slopes are constructed. Therefore, Golder recommends that embankment slope alternatives not be considered further for the proposed stream bank enhancements along Peach Island Creek.

Furthermore, Golder recommends that structural retaining wall structures (i.e., steel sheet pile or gravity wall systems) be evaluated to provide the desired stream bank enhancements along Peach Island Creek.

References

Golder Associates Inc. (1995), FFS Site Characterization for the 216 Paterson Plank Road NPL Site, Carlstadt, New Jersey, 1995

Rocscience Inc. (2005), *Slide Version 5.019*, Toronto, Canada

USACE (2003), *Engineering and Design Slope Stability*, EM 1110-2-1902, 31 October 2003

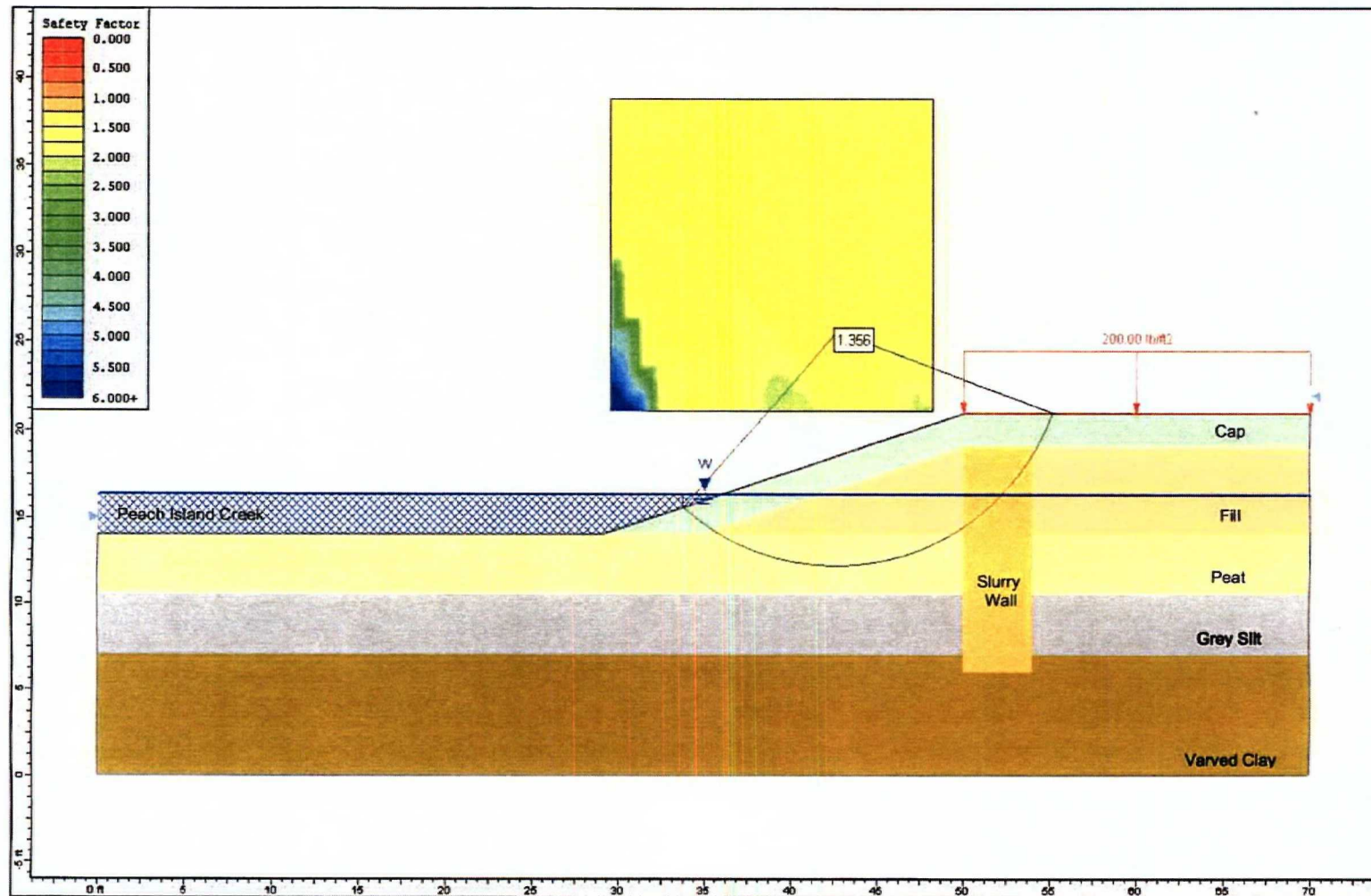


Figure 1. Slope stability analysis of a capped 3H:1V slope.

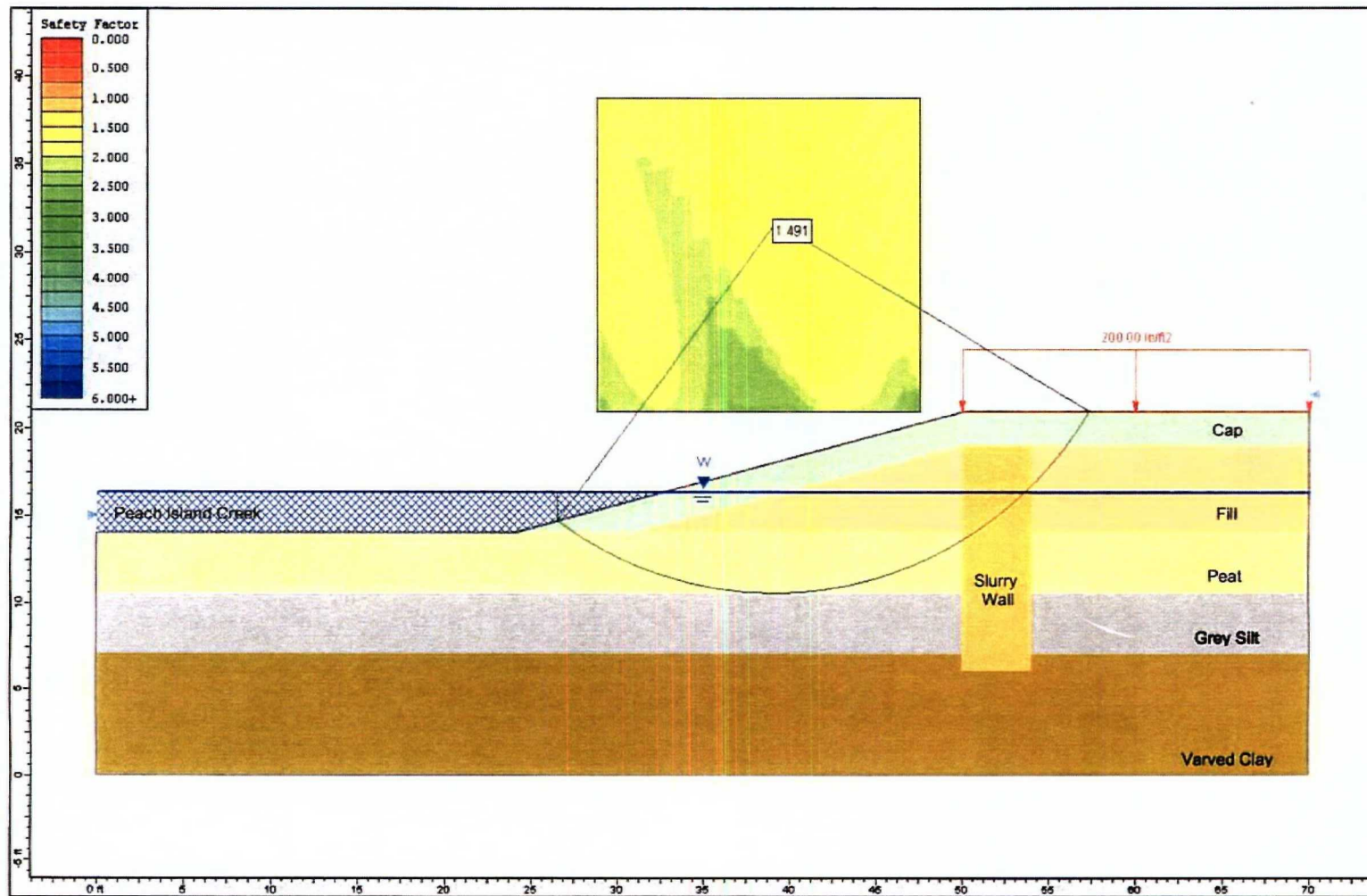


Figure 2. Slope stability analysis of a capped 4H:1V slope.

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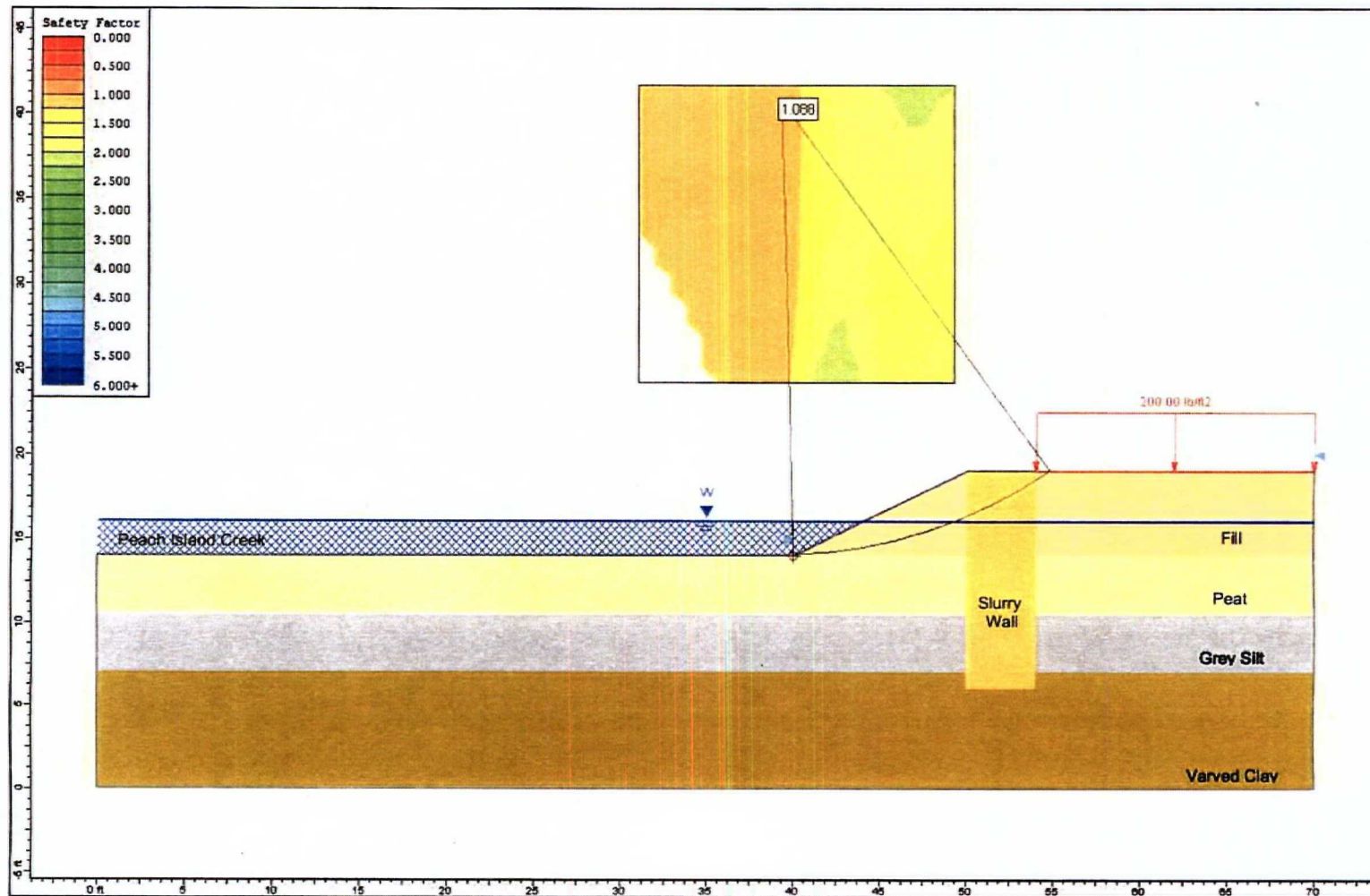
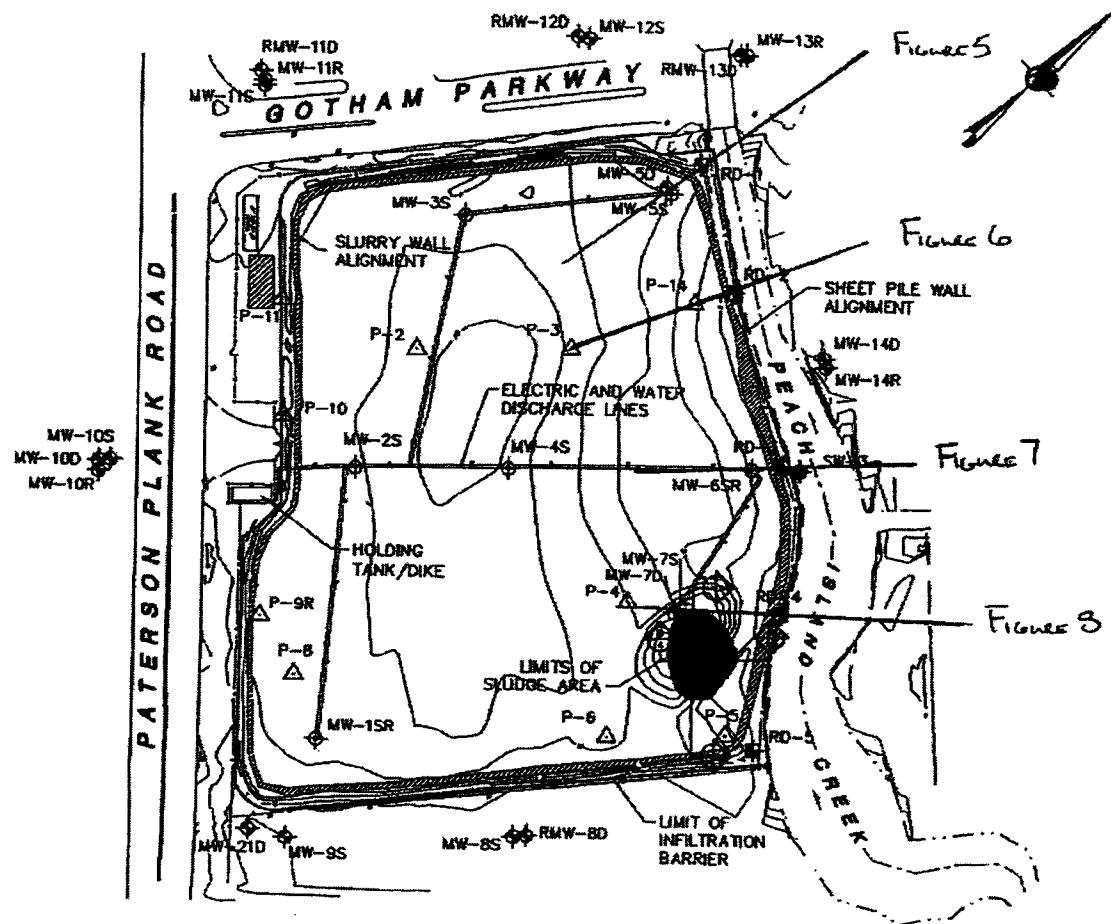


Figure 3. Short-term slope stability analysis of a typical slope during construction. The critical slip was forced through the toe of the slope, which co-exists with the top of the remaining sheet pile wall.



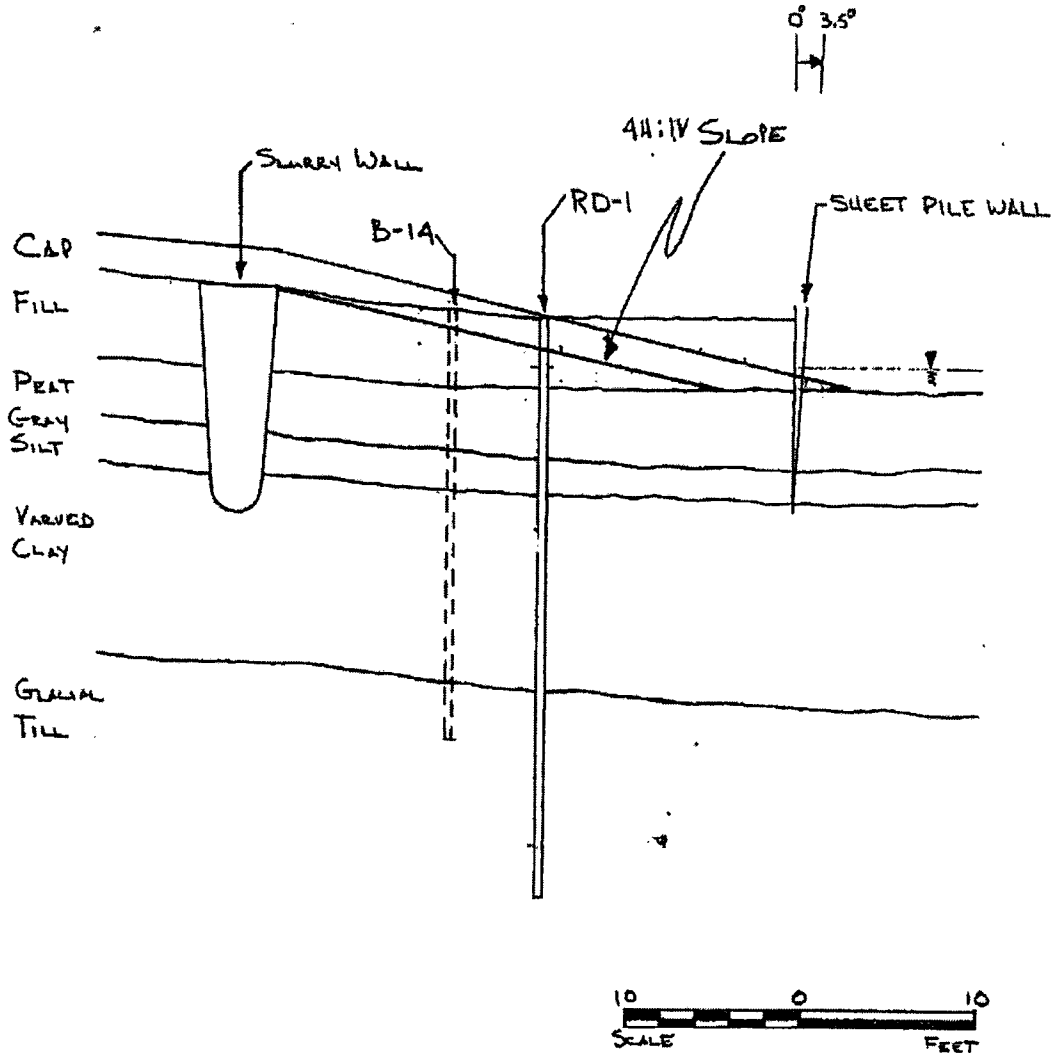
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SUBJECT 4H:1V DESIGN SLOPE AT WELL RD-1: FIGURE 5

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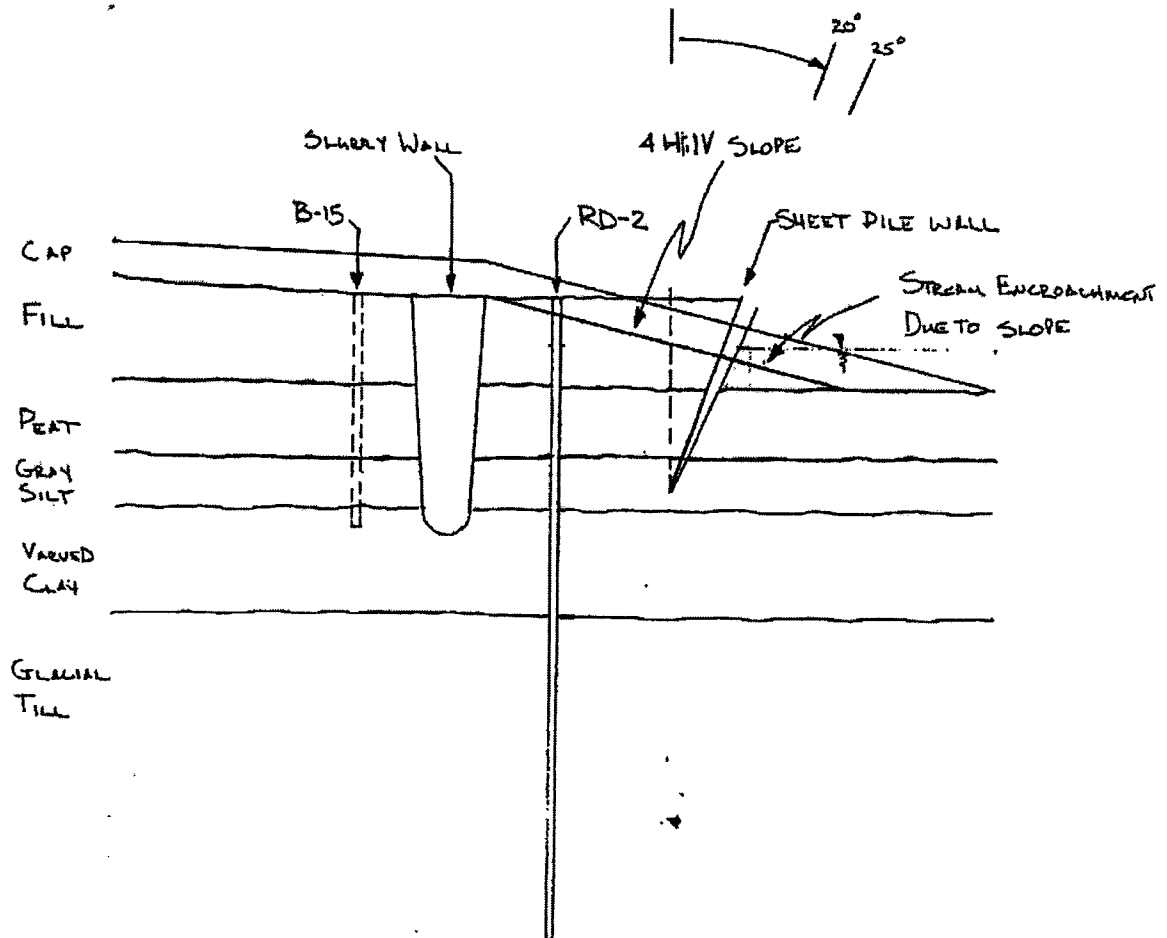
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SUBJECT 4H:IV DESIGN SLOPE AT WELL RD-2: FIGURE 6

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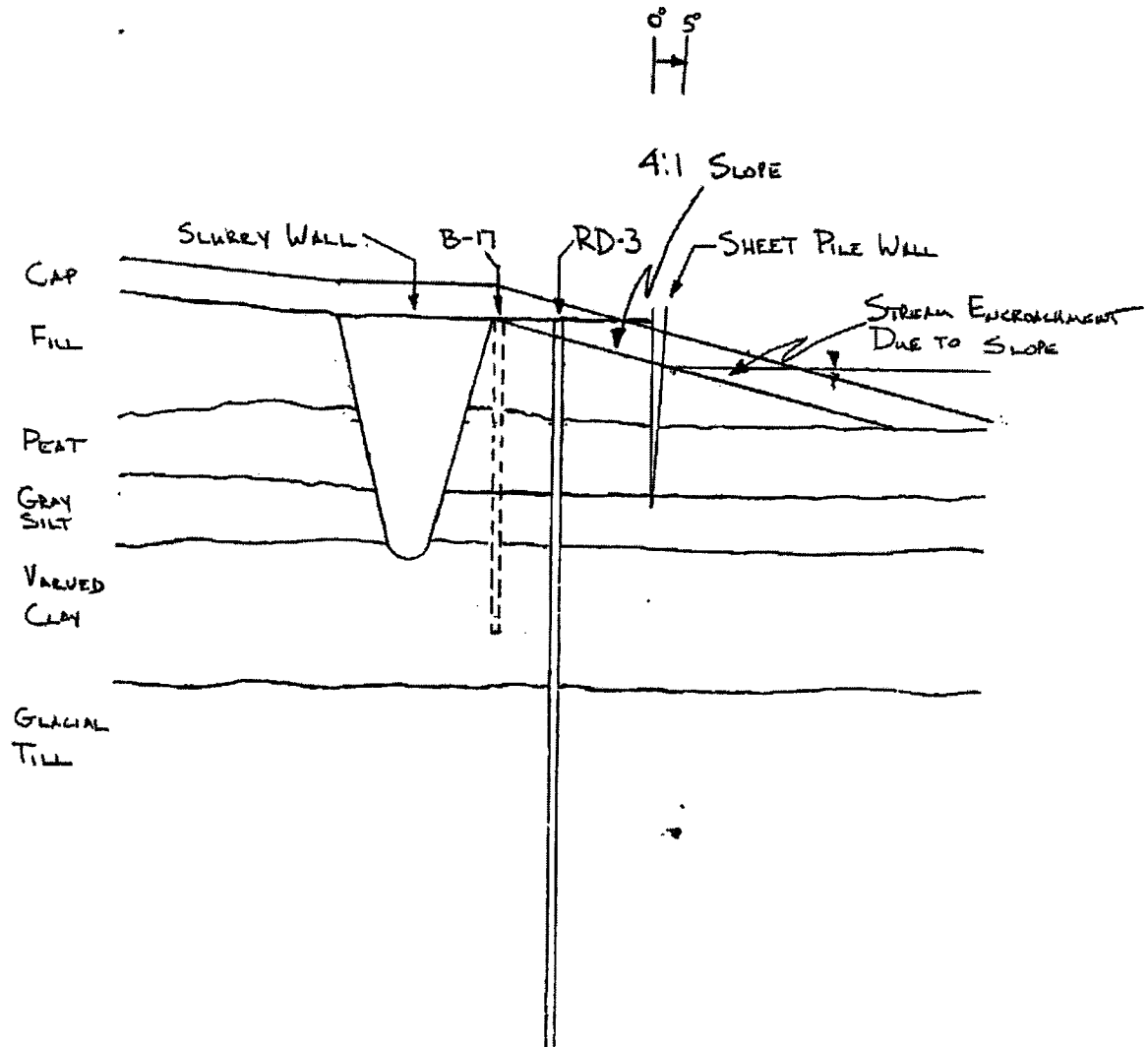
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SUBJECT 4H:1V Design Slope AT WELL RD-3: Figure 7

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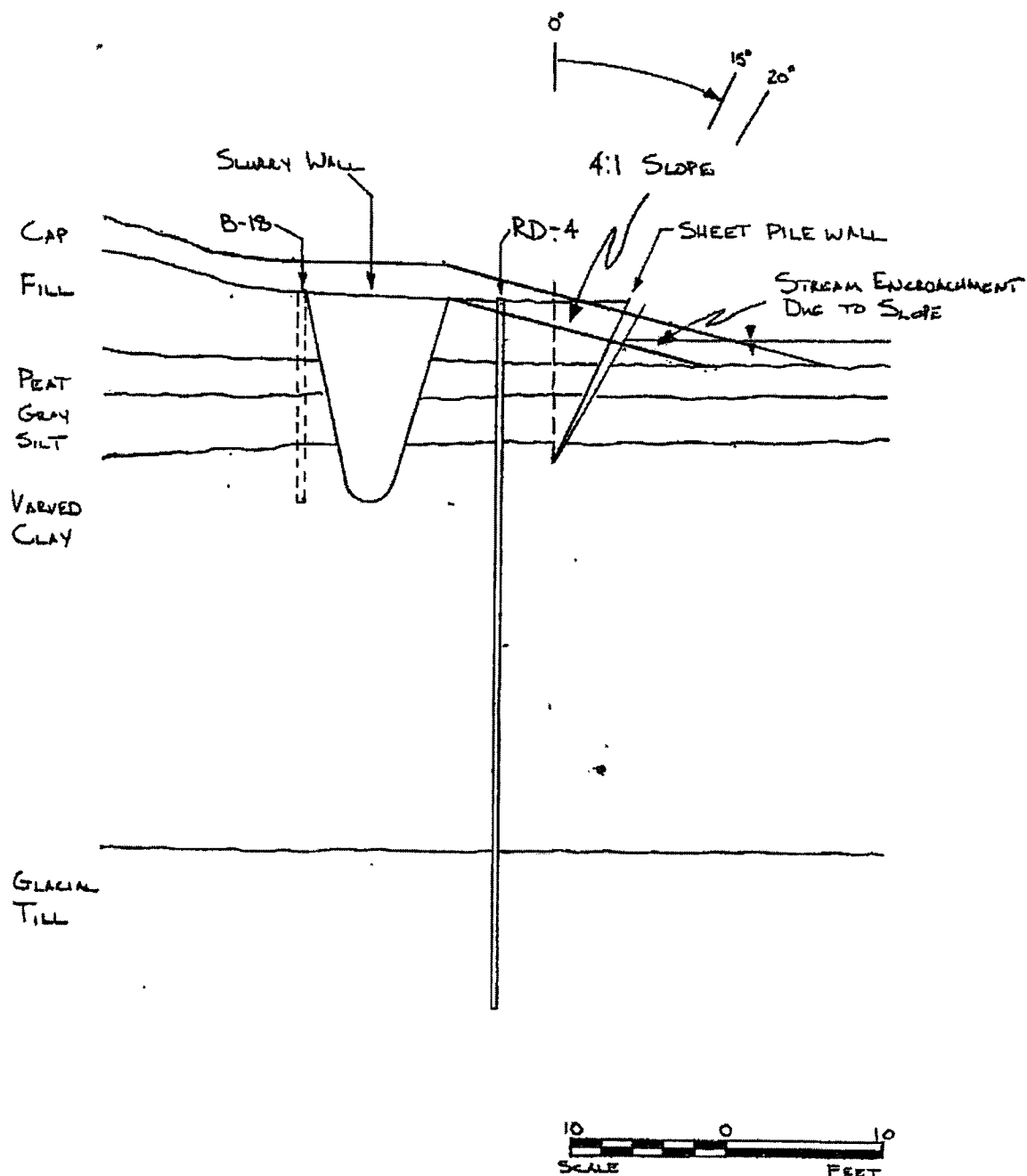
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SUBJECT 4H:IV Design Slope at Well RD-4; Figure 8

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SUBJECT Sheet Pile Wall design calculation		
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Objective

The objective of this analysis is to perform design calculation of sheet pile wall as a retaining structure along the Peach Island Creek at 216 Paterson Plank Road site, Carlstadt, Bergen County, New Jersey. The sheet pile wall will replace the existing sheet pile wall as the primary retaining structure. It is assumed that in this analysis the sheet pile wall (SPW) is cantilevered and penetrated into glacial till to prevent failure.

Reference:

1. Golder Associates Inc., 2005 Preliminary (35% Design) design report, operable unit 2 (OU-2), December 2005
2. As-built construction drawings, interim remedy, SCP, Carlstadt, supervised site, August 1992
3. Golder Associates Inc., 2005 Preliminary sheet pile wall calculations, December, 2005
4. Profi ARBED, ProSheet 22 help file
5. Pile Buck Inc., 2003 SPW 911 help file
6. FHWA, 2005 Earth retaining structures, reference manual FHWA NHI-05-046, March 2005
7. Das, B.M. 2004 Principles of foundation engineering, 5th ed.

Assumptions:

1. See Table 1 for all geotechnical engineering design parameters used for this design. The design values are from reference 1.
2. Subsurface design profiles are based on subsurface survey of borings RD-1 through RD-4 and sheet pile wall details provided in references 1 & 2. See Figure 1 for site area and cross section locations and Figures 2 to 5 for 4 different design cross sections

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3> For SPW analysis, a uniform surcharge of 300 psf is assumed. A perimeter drainage channel is proposed along the new SPW as shown in sub-surface soil profile. The channel is about 2' wide and 3' deep. To simplify and be conservative the channel is assumed to be filled with soils in this analysis. The 2' thick cap soils are assumed to be a uniform surcharge applied to the existing soils. It's assumed 1' soils will be added to existing grade to obtain proposed 10% slope (see 52). So the total surcharge will be

$$300 \text{ psf} + (120 \text{ psf}) \times (3') = 660 \text{ psf}$$

4> The Site has existing slopes ranging from about one (1) percent to 152 percent with the exception of a mounded area located in the Northeast corner of the Site. The proposed landfill cap grading would be designed to maintain the drainage patterns with radial drainage from the central portion to new drainage channels. The slope in the proximity of new SPW will be ten (10) percent (10%) max. In further analysis, level ground situation is adopted for simplification.

5> Sediment levels in Peach Island Creek were measured at six (6) Sediment Survey Points (SSP) along the existing SPW. "Firm bottoms" were estimated to vary from 4.5 to 5.0 feet beneath the top of installed SPW. It is assumed that the sediment levels didn't change along the Peach Island Creek. Also given is that the sediment is approximately 2 feet below the water surface of the creek. The new SPW will locate about 3 to 6 feet behind the existing SPW. So the elevation of the top of new SPW will be about 0.3 to 0.6 feet higher. Therefore the water surface is assumed to be 6 feet lower than the top of new SPW and sediment in the creek to be 8 feet lower than the top of new SPW.

Methodology

The SPW analysis was performed for continuous wall sections that would be driven to a sufficient depth to become vertical, fixed as

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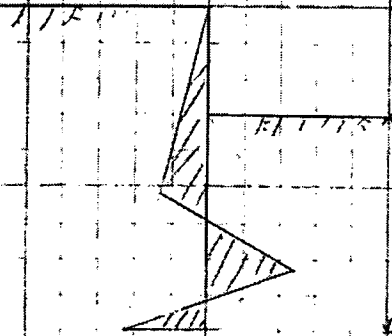
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a. Cont. lever in resisting active earth pressure.

A simplified design section will be analyzed at four designated cross-sections RD-1 RD-2 RD-3 and RD-4. The simplified design section is as follows.



D_1 = theoretical penetration depth.
increase D_1 by 20 to 40 percent will result in approximate factor of safety of 1.5 to 2.

For the SPW analysis, a computer program "Plasheet 2.2" by Prof. ARBED is adopted here and the another computer program "SPW 911" by Pile Buck Inc. is used to verify the results. In the analysis of "Plasheet", level ground situation is assumed to simplify the analysis. In the analysis of "SPW 911", both level and inclined ground are analyzed. Using the input parameters in Table 1 and the cross-sections in Figures 2 to 5, the following were calculated:

- 1) Total pressure diagrams;
- 2) Moment diagrams, and
- 3) deflection diagrams.

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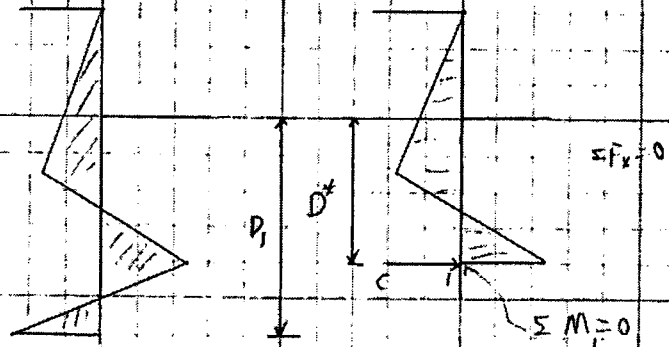
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To estimate the required embedment depth, simplified "Blum" method will be applied. The method resolves the soil stress inflection below the point of fixity by incorporating a constant force at the toe of sheeting and maintaining static equilibrium about the pile tip.



In ProSheet program calculated depth D^* automatically increased by an overlength to obtain the program output. Sheet pile tip depth D_1 . Finally D_1 is increased by 30% to obtain an approximate factor of safety of about 1.75.

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Calculation

Next, a hand calculation of cross-section at RD 11 will be presented as an example. See Figure 2 for subsurface profile.

1) Assume a trial depth D^* of 19.5 feet

Behind the SPW (landward)

depth (feet) from existing surface	soil layer	K_a	$\Delta P_0 = \gamma z$ (ksf)	$\Delta P = (10\gamma_0) K_a$ (ksf)	Wall pressure = $\frac{P_1 + P_2}{2}$ (ksf)
0	1	0.27 ✓	0.66	0.19	0.18
3	1	0.27 ✓	0.12(3) = 0.36	0.10	0.27
3	1 (under GWT)	0.27 ✓	0.66 + 0.36 = 1.02	0.27	0.27
4	1 (under GWT)	0.27 ✓	0.08(1) = 0.08	0.02	0.29
4	2	1 ✓	1.078	1.978(4) - 2(0.2)(1) = 0.88	
8	2	1 ✓	0.08(4) = 0.32	0.07	0.95
8	3	1 ✓	1.150	1.15(1) - 2(0.2)(1) = 0.75	
12	3	1 ✓	0.08(4) = 0.32	0.19	0.94
12	4	1 ✓	1.342	1.342(1) - 2(0.2)(1) = 0.14	
16.5	4	1 ✓	0.08(4.5) = 0.36	0.26	0.40
16.5	5	1 ✓	1.603	1.603(1) - 2(0.2)(1) = 0.80	
21	5	1 ✓	0.053(4.5) = 0.24	0.24	1.03 ✓
21	6	0.33 ✓	1.842	1.842(0.8) - 2(0.2)(0.8) = 0.37	
24.5	6	0.33 ✓	0.058(3.5) = 0.20	0.07	0.44 ✓

Where $K_a = \frac{\cos^2(\phi - \theta)}{\cos^2 \theta \cos(\theta + \delta) \left[1 + \frac{\sin(\phi + \delta) \sin(\phi - \beta)}{\cos(\theta + \delta) \cos(\theta - \beta)} \right]^2}$ ✓

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in front of	SPW	(water wall)				
depth (feet) from existing surface	soil layer	k_p	$\sigma'_v = \gamma'_z$ (ksf)	$\sigma'_h = (\sigma'_v) K_p$ (ksf)	wall pressure = $\sigma'_h + \sigma'_q$ (ksf)	
5	2	1 ✓	0	$0(1) + 2(0.1)(1) = 0.2$		
8	2	1 ✓	0.05	0.05		0.25
8	3	1 ✓	0.05	$0.05(1) + 2(0.2)(1) = 0.45$		
12	3	1 ✓	0.19	0.19		0.64
12	4	1 ✓	0.24	$0.24(1) + 2(0.6)(1) = 1.44$		
16.5	4	1 ✓	0.24	0.24		1.70
16.5	5	1 ✓	0.30	$0.30(1) + 2(0.6)(1) = 1.5$		
21	5	1 ✓	0.24	0.24		1.54 ✓
21	6	4.33 ✓	0.74	$0.74(4.33) + 2(0.2)(4.33) = 4.03$		
24.5	6	4.33 ✓	0.20	0.87		4.90

where

$$K_p = \frac{\cos^2(\theta + \phi)}{\cos^2\theta \cos(\theta - \delta)} \left[1 - \frac{\sin(\phi + \delta) \sin(\theta + \beta)}{\cos(\theta - \delta) \cos(\theta - \beta)} \right]^2$$

pressure diagram ✓

Active

Passive

depth

3

5

8

12

16.5

21

24.5

0.25

0.3

0.4

0.8

0.4

0.37

0.2

0.45

0.64

1.44

1.5

1.54

4.90

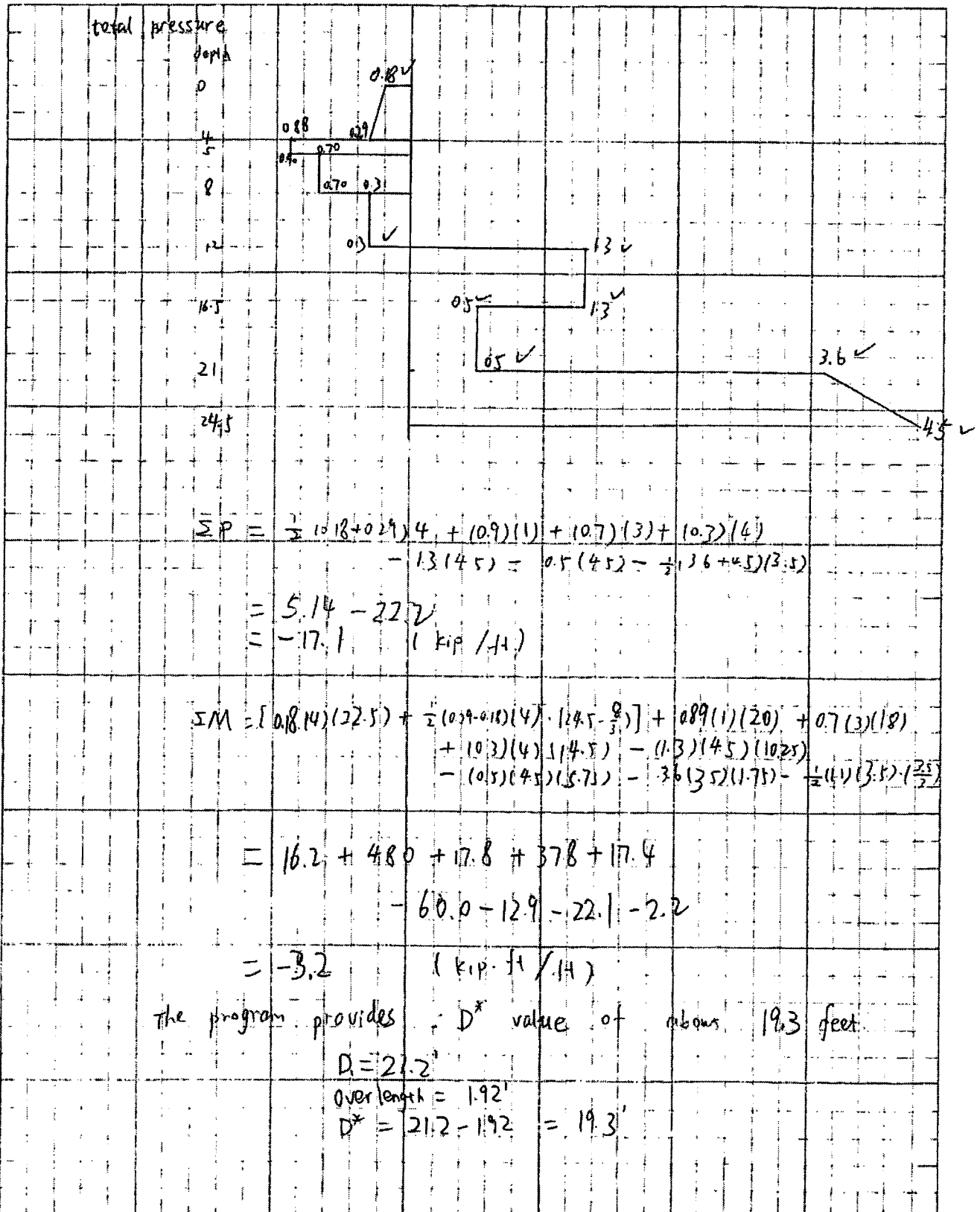
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Pre-Final (95% Design) Design Report
Operable Unit 2 (OU-2)
216 Paterson Plank Road Site
Carlstadt, Bergen County, New Jersey

Table 1 - Geotechnical Design Parameters

Material/Strata	Index Properties			Consolidation Parameters					Strength Parameters		
	γ_{sat}	w_n	PI	e_o	Compression Indices			C_v	ϕ	c	S_u
					C_c	C_{α}	C_{α}/C_c				
Imported Fill Materials:											
Common, Grading Fill	120								33	0	
Structural Fill	120								33	0	
Subsurface Deposits:											
Fill	120								33	0	
Meadow Mat/Peat	80	300		9.0	6.00	0.36	0.06	1.00	0		100
Organic Silt/Clay	110	120	40	2.0	0.90	0.05	0.05	0.20	0		200
Upper Varved Clay	120	30	20	0.8	0.40	0.02	0.04	0.20	0		600
Lower Varved Clay	115	50	30	1.1	0.60	0.02	0.04	0.30	0		400
Glacial Till	120	10	5						28	200	

Legend: γ_{sat} = Unit Weight, lbs/ft³ (psf)
 w_n = Natural Water Content, %
PI = Plasticity Index
 e_o = Initial Void Ratio
 ϕ = Internal Friction Angle, degrees
 c = Cohesion, lbs/ft² (psf)
 S_u = Existing Mobilized Undrained Shear Strength, lbs/ft² (psf)
 C_c = Compressibility Index
 C_{α} = Secondary Compression Index
 C_v = Coefficient of Consolidation, ft²/day

Notes:

- Design values shown herein are based on laboratory testing data, published literature, experiences with similar materials, generally accepted industry standards, and professional geotechnical engineering judgment.
- C_{α} and C_v values vary with load, and values shown herein typically correspond to a load increment of 2 tsf.

Table 2 - Summary of Program Outputs

Site	Method	H feet	D ₁ (output) feet	D(=1.3*D ₁) feet	L feet	M _{max} kip-ft/ft	Stress _{max} kip/in ²	Steel Grade kip/in ²	FOS
RD-1	ProSheet	8.0	21.2 ✓	27.6 ✓	35.6 ✓	39.4 ✓	2.2 2.0	34.8 ✓	1.6 ✓
	SPW911-Level	8.0	20.6 ✓	26.7 ✓	34.7 ✓	40.1 ✓			
	SPW911-Slope	8.0	21.3 ✓	27.6 ✓	35.6 ✓	45.6 ✓			
RD-2	ProSheet	8.0	15.4	20.0	28.0	20.2 ✓	10.9	34.8	3.2
	SPW911-Level	8.0	16.1	21.0	29.0	20.8 ✓			
	SPW911-Slope	8.0	16.8	21.9	29.9	23.2 ✓			
RD-3	ProSheet	8.0	16.4	21.3	29.3	22.0 ✓	11.9	34.8	2.9
	SPW911-Level	8.0	18.8	24.5	32.5	23.2 ✓			
	SPW911-Slope	8.0	20.2	26.2	34.2	26.2 ✓			
RD-4	ProSheet	8.0	11.1	14.4	22.4	11.6 ✓	6.3	34.8	5.5
	SPW911-Level	8.0	12.2	15.8	23.8	12.2 ✓			
	SPW911-Slope	8.0	12.9	16.8	24.8	13.7 ✓			

Note: Swell varies from 0.3 to 3.0 inches, per SPW911 and using A2-18 sheet pile sections. Typical Swell vary between 1.0 and 3.0 inches, as measured at top of wall

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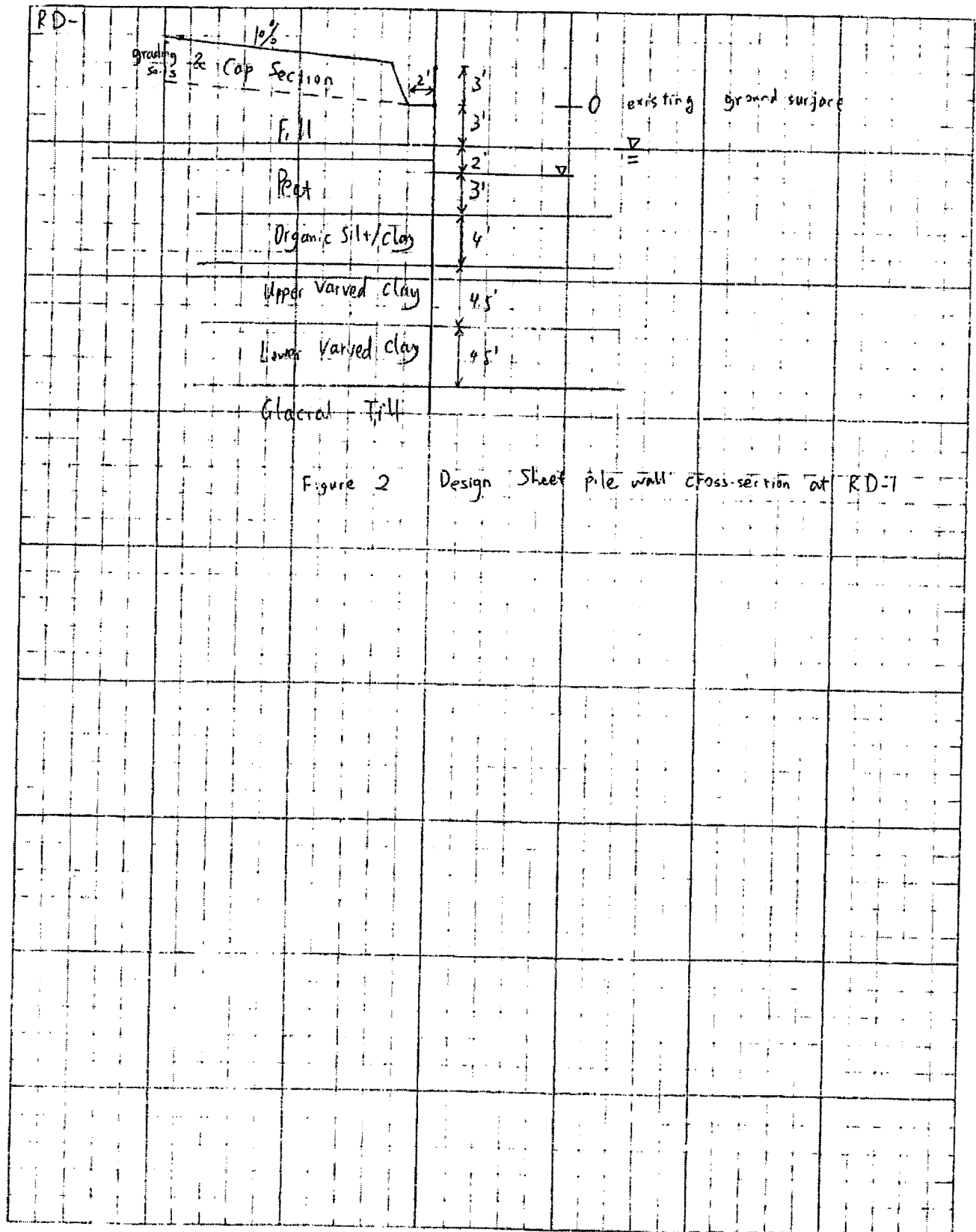
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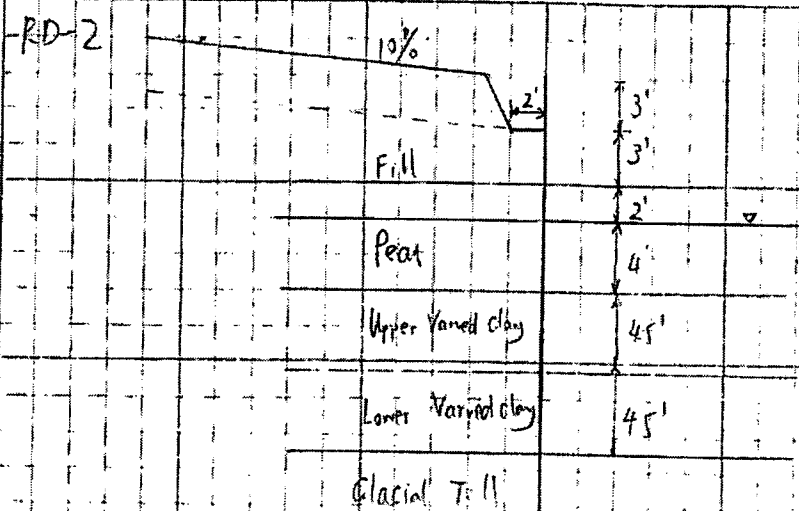


Figure 3 Design SPW cross-section at RD-2

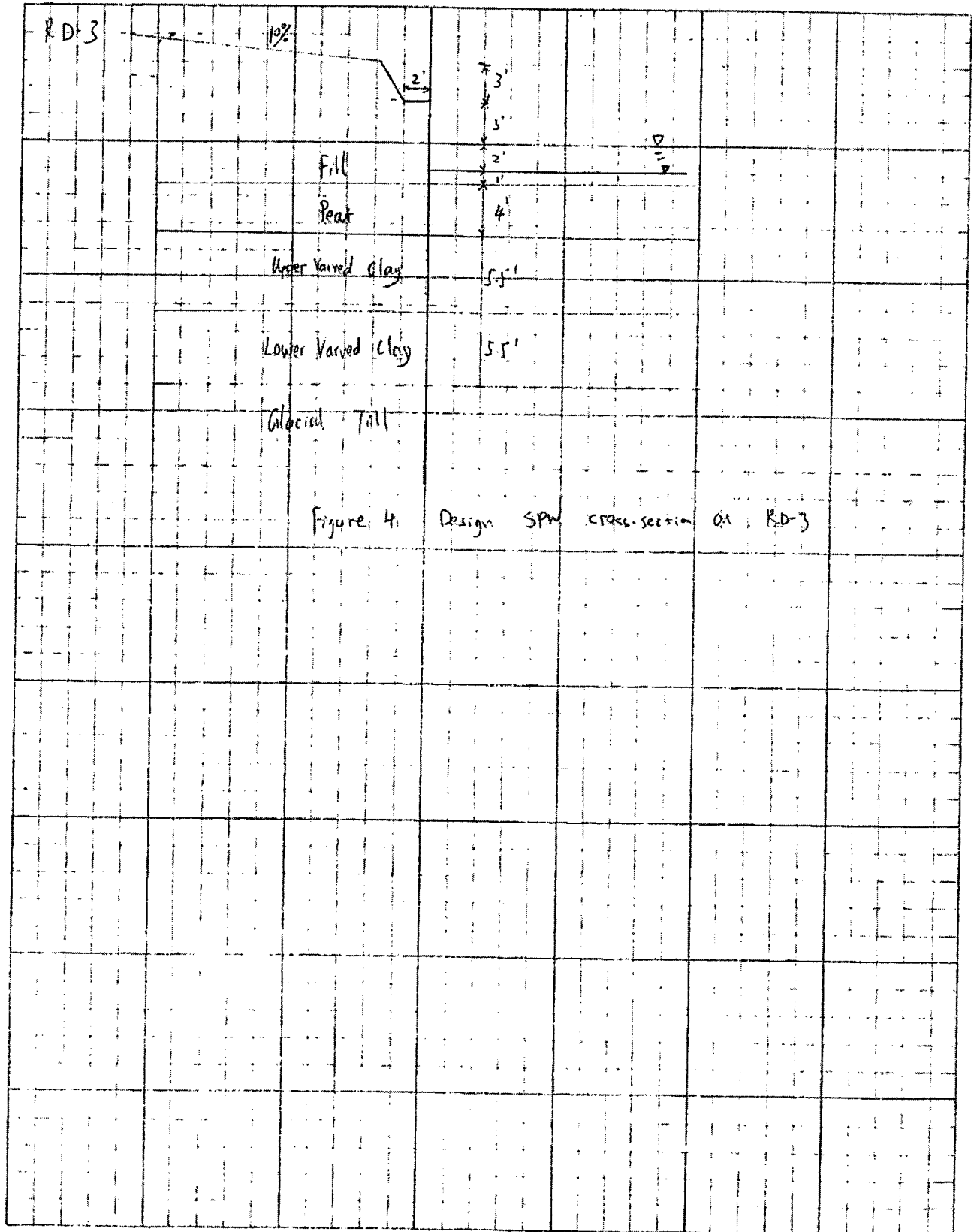
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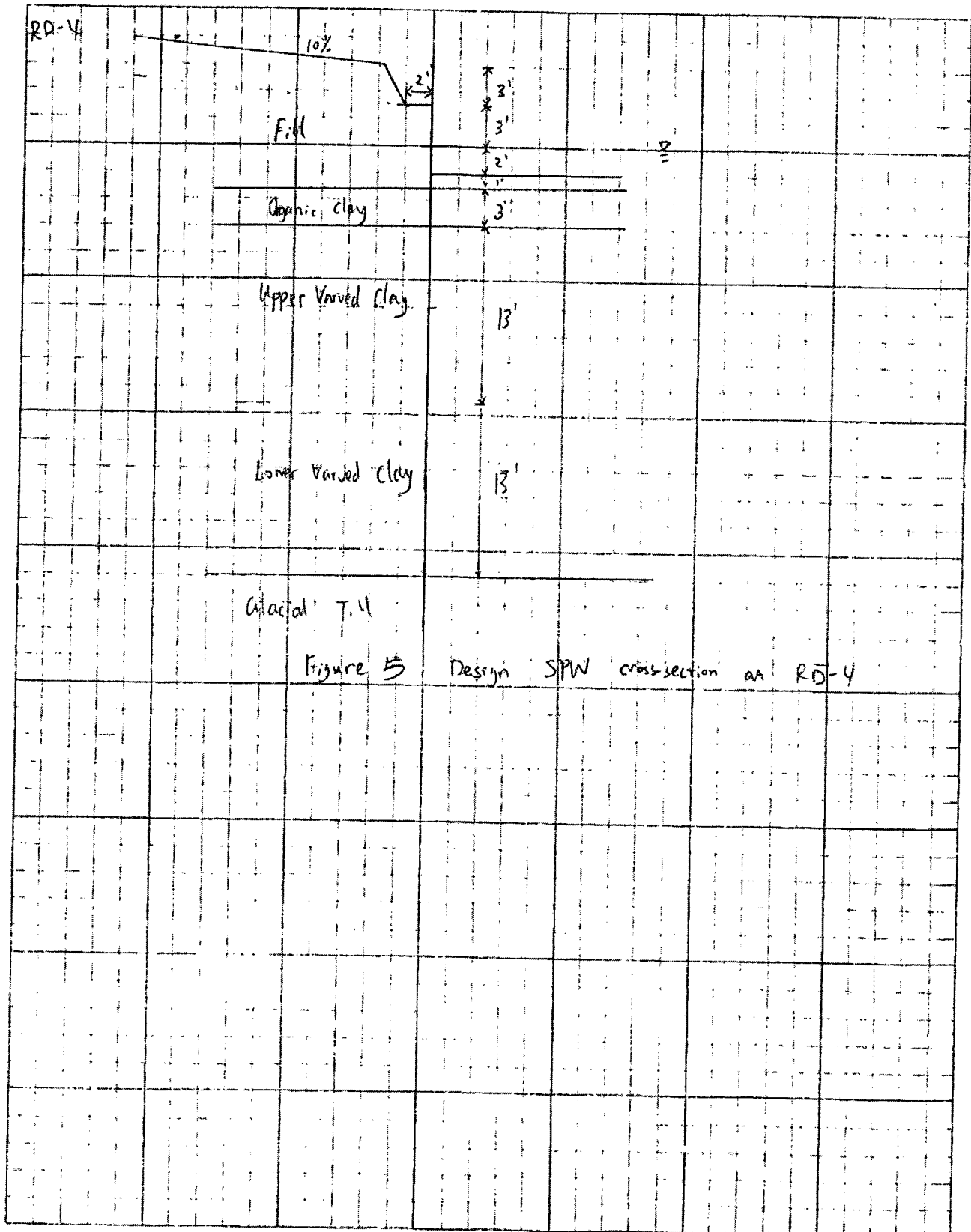
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Sheet Pile Design According to Blum-Method

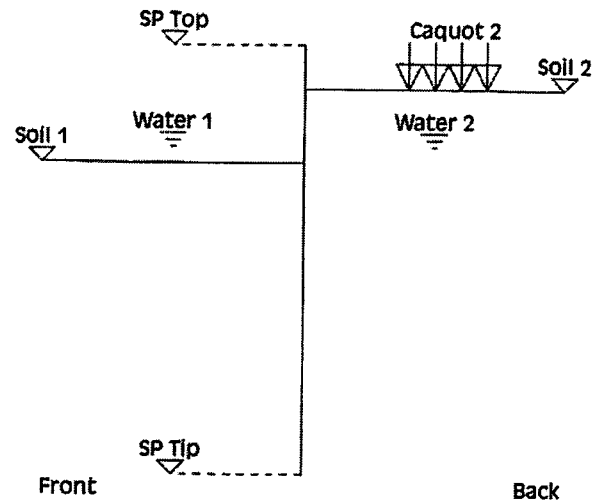
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Date: 9/12/2006
Author: DKL
Company:
Comment:

Geodata

	Unit
Sheet Pile Top Level (ft)	-3.000
Sheet Pile Tip Level (ft)	26.200
Soil Level in Front (ft)	5.000
Soil Level behind (ft)	0.000
Anchor level (ft)	-3.000
Water Level in Front (ft)	3.000
Water Level behind (ft)	3.000
Soil Surface Inclination in Front (Deg)	0.000
Soil Surface Inclination behind (Deg)	0.000
Caquot Surcharge in Front (kip/ft ²)	0.000
Caquot Surcharge behind (kip/ft ²)	0.660
Anchor Inclination (Deg)	0.000
Earth support	Cantilever

21.2

✓



Soil Layers

Layers In Front

	Layer Tip (ft)	Density Moist (kip/ft ³)	Density Submerged (kip/ft ³)	Kph	Phi (Deg)	Delta (Deg)	Cohesion (kip/ft ²)
Layer 1	8.000	0.080	0.018	1.000	0.000	0.000	0.100
Layer 2	12.000	0.110	0.048	1.000	0.000	0.000	0.200
Layer 3	16.500	0.120	0.058	1.000	0.000	0.000	0.600
Layer 4	21.000	0.115	0.053	1.000	0.000	0.000	0.400
Layer 5	40.000	0.120	0.058	4.216	28.000	-14.000	0.200

Layers behind

	Layer Tip (ft)	Density Moist (kip/ft ³)	Density Submerged (kip/ft ³)	Kph	Phi (Deg)	Delta (Deg)	Cohesion (kip/ft ²)
Layer 1	4.000	0.120	0.058	0.256	33.000	16.500	0.000
Layer 2	8.000	0.080	0.018	1.000	0.000	0.000	0.100
Layer 3	12.000	0.110	0.048	1.000	0.000	0.000	0.200
Layer 4	16.500	0.120	0.058	1.000	0.000	0.000	0.600
Layer 5	21.000	0.115	0.053	1.000	0.000	0.000	0.400
Layer 6	40.000	0.120	0.058	0.317	28.000	14.000	0.200

Pile Section

Name	AZ13-1
Inertia (in ⁴ /ft)	132.835
Modulus (in ³ /ft)	22.320
Area (in ² /ft)	5.939
Mass (lbs/ft ²)	20.215
Steel Grade (lb/in ²)	34795.867
Requested Safety	1.500

Pile Check

		Depth (ft)
Name	AZ13-1	
Inertia (in ⁴ /ft)	132.835	
Modulus (in ³ /ft)	22.320	
Area (in ² /ft)	5.939	
Mass (lbs/ft ²)	20.215	
Steel Grade (lb/in ²)	34795.867	
Minimal Moment (kip-ft/ft)	-0.882	24.314
Maximal Moment (kip-ft/ft)	39.360	15.904
Normal Forces at Max. Moment (kip/ft)	0.000	24.314
Normal Forces at Min. Moment (kip/ft)	0.271	15.904
Deflection at Min. Moment (ft)	0.000	24.314
Deflection at Max. Moment (ft)	-0.034	15.904
Min. Stress at Min. Moment (lb/in ²)	-474.412	24.314
Max. Stress at Min. Moment (lb/in ²)	474.412	24.314
Min. Stress at Max. Moment (lb/in ²)	-21119.928	15.904
Max. Stress at Max. Moment (lb/in ²)	21211.111	15.904
Safety > Req. Safety = 1.500	1.640	
Sheet Pile Top Level (ft)	-3.000	
Sheet Pile Tip Level (ft)	26.200	
Sheet Pile Length (ft)	29.200	
Included OverLength (ft)	1.920	
Vertical Equilibrium (kip/ft)	1.052	
Anchor Force (horiz.) (kip/ft)	0.000	

$$(S_x)_{req} = \frac{M}{F_b} = \frac{39.4 \text{ kip-ft}}{0.66 F_y}$$

$$F_y = 50 \text{ ksi}$$

$$F_b = 33 \text{ ksi}$$

$$\therefore (S_x)_{req} = \frac{(39.4)(12)}{33 \text{ ksi}}$$

$$(S_x)_{req} = \underline{14.3 \text{ in}^3/\text{ft}}$$

$$(S_x)_{req} < (S_x)_{AZ-13}$$

$\therefore \text{OK!}$

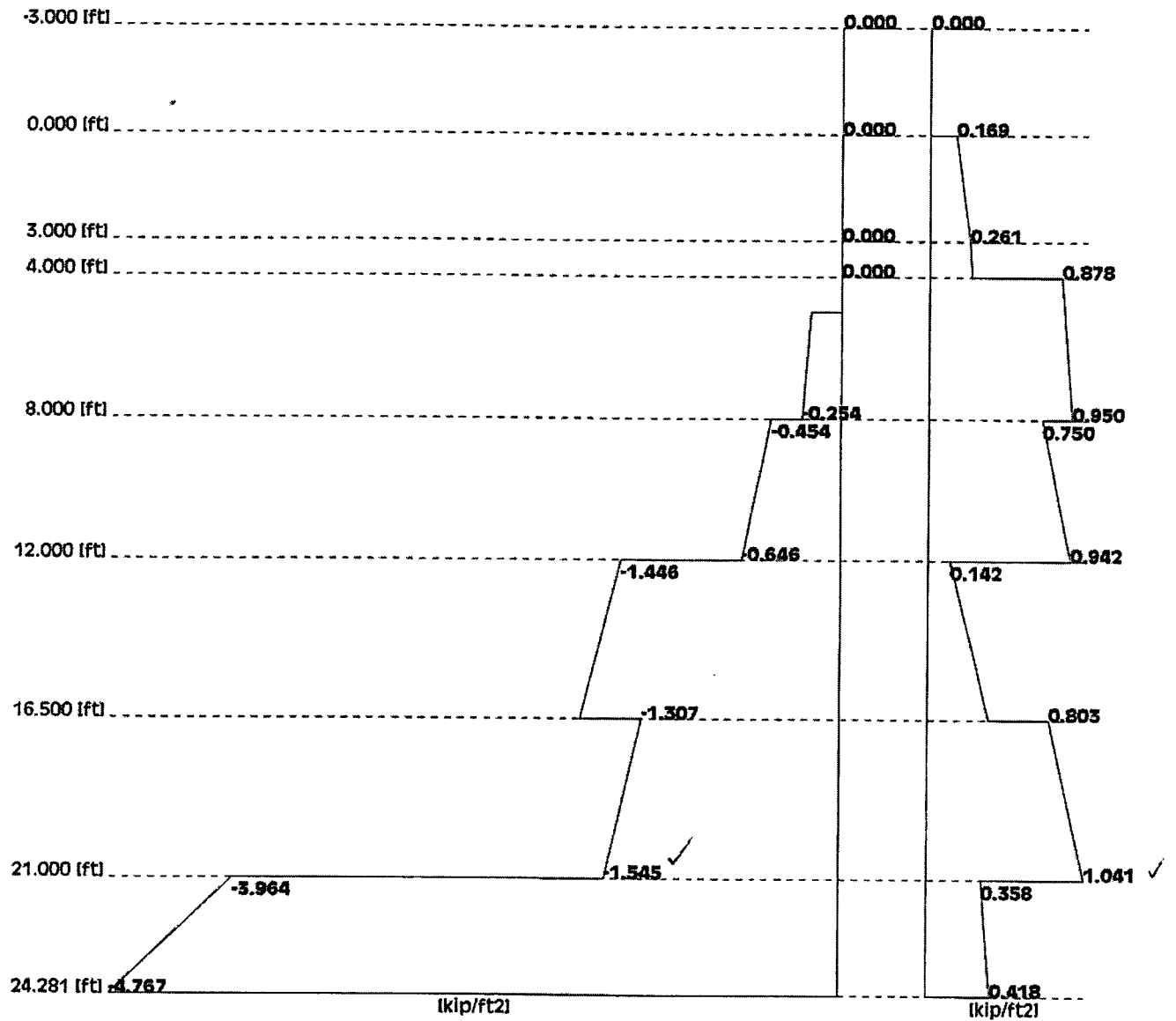
$$H = 3 + 5 = 8'$$

$$D_1 = 26.2 - 5 = 21.2'$$

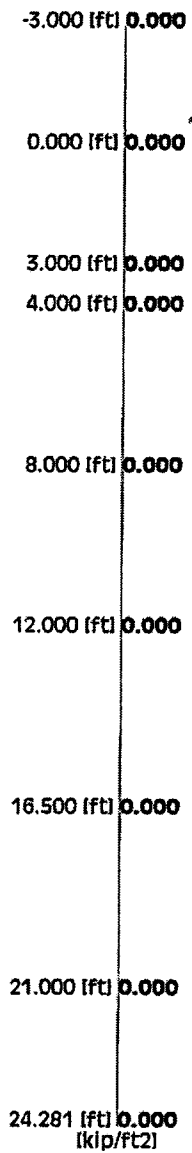
$$D = 1.3 D_1 = 27.6' \quad \text{corresponding to } FS \approx 1.75$$

$$L = H + D = 35.6'$$

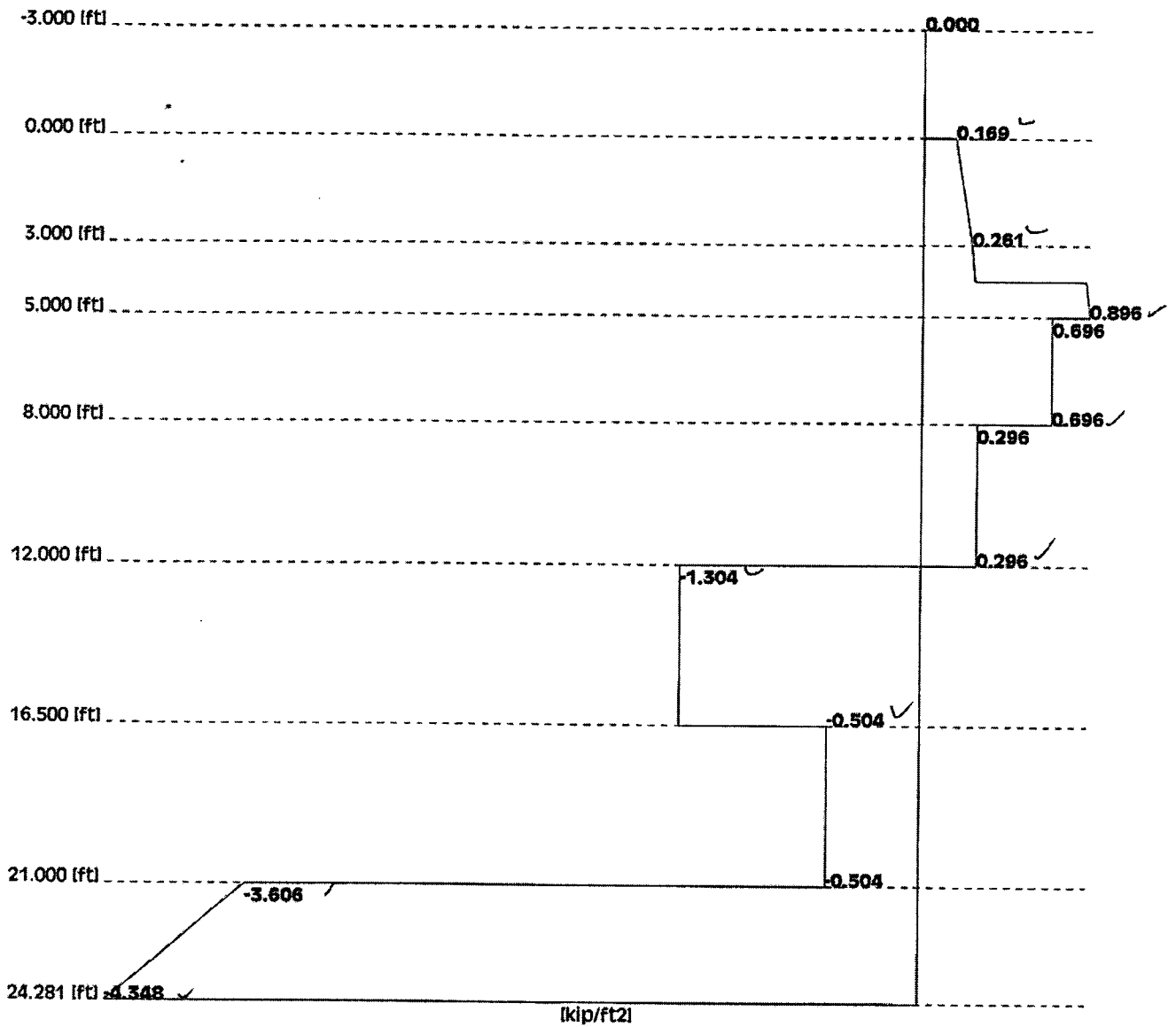
Earth Pressure Diagram



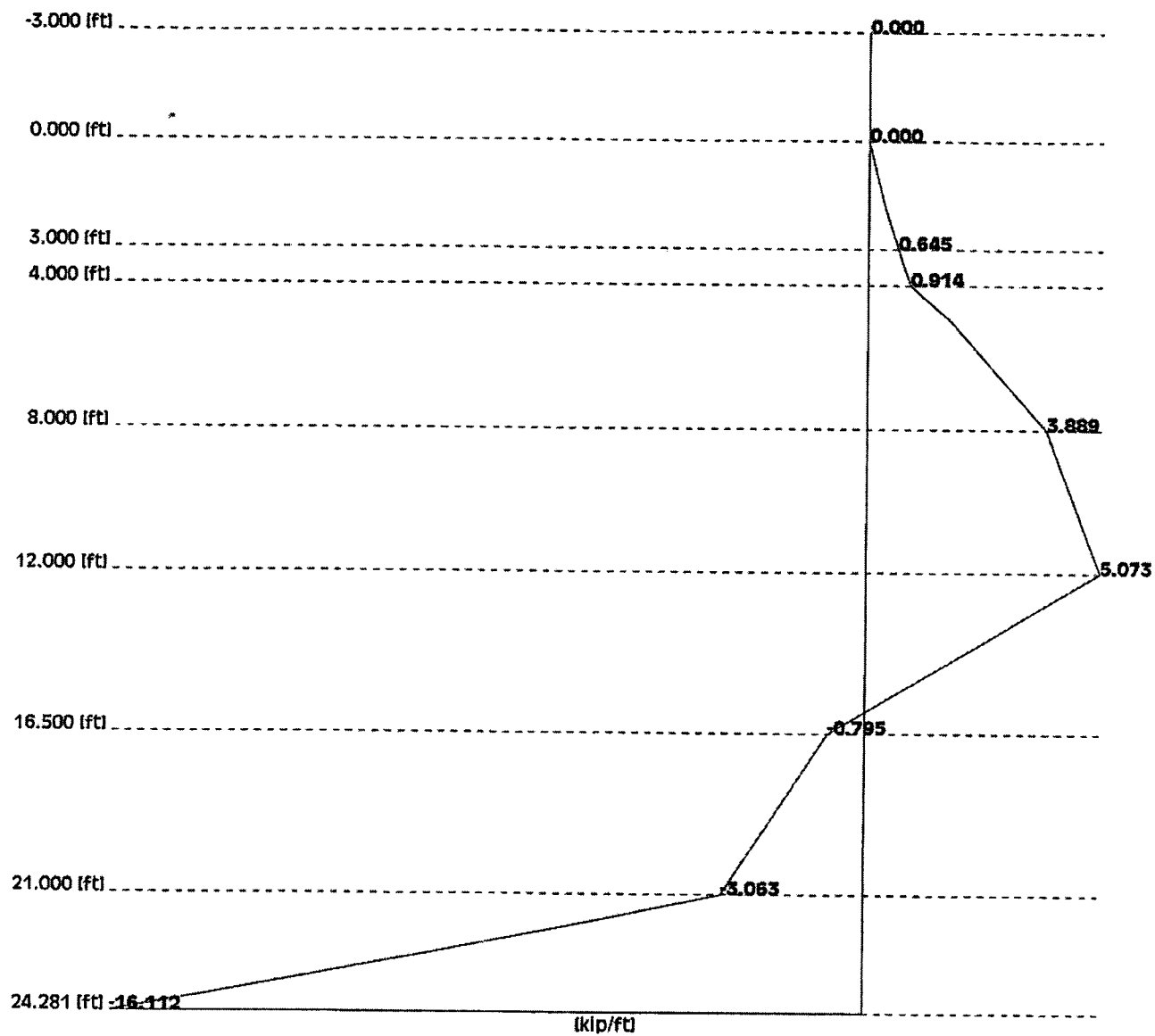
Water Pressure Diagram



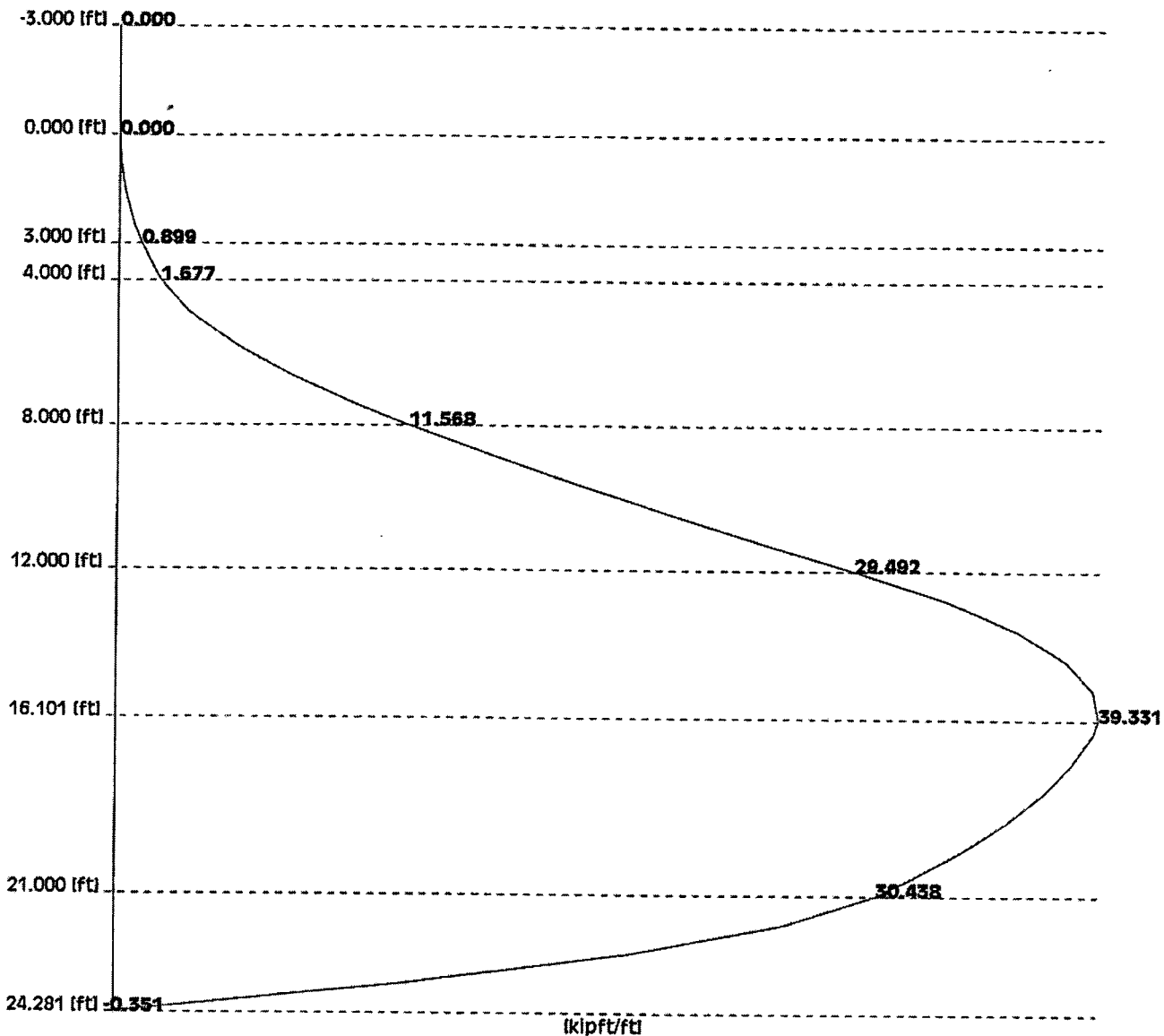
Total Pressure Diagram



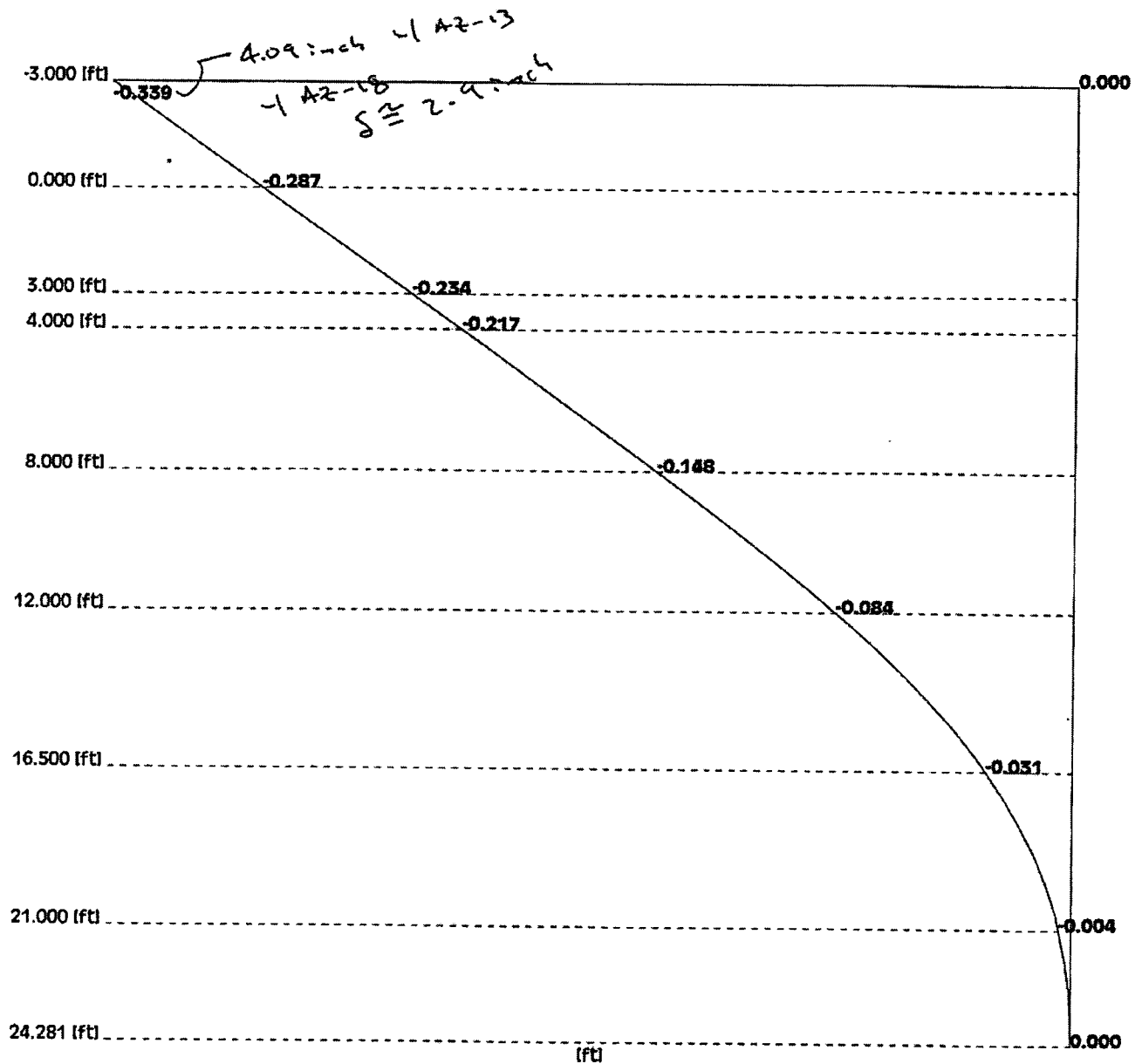
Cross Force Diagram



Moment Diagram



Deflection Diagram



06 to 92

Client: 216 Paterson Plank Road
Cooperating PRP Group

Title: Sheet Pile Wall Design Section
at RD-1

Designer: David Kun Li

Page: 1

Date: 9.13.06

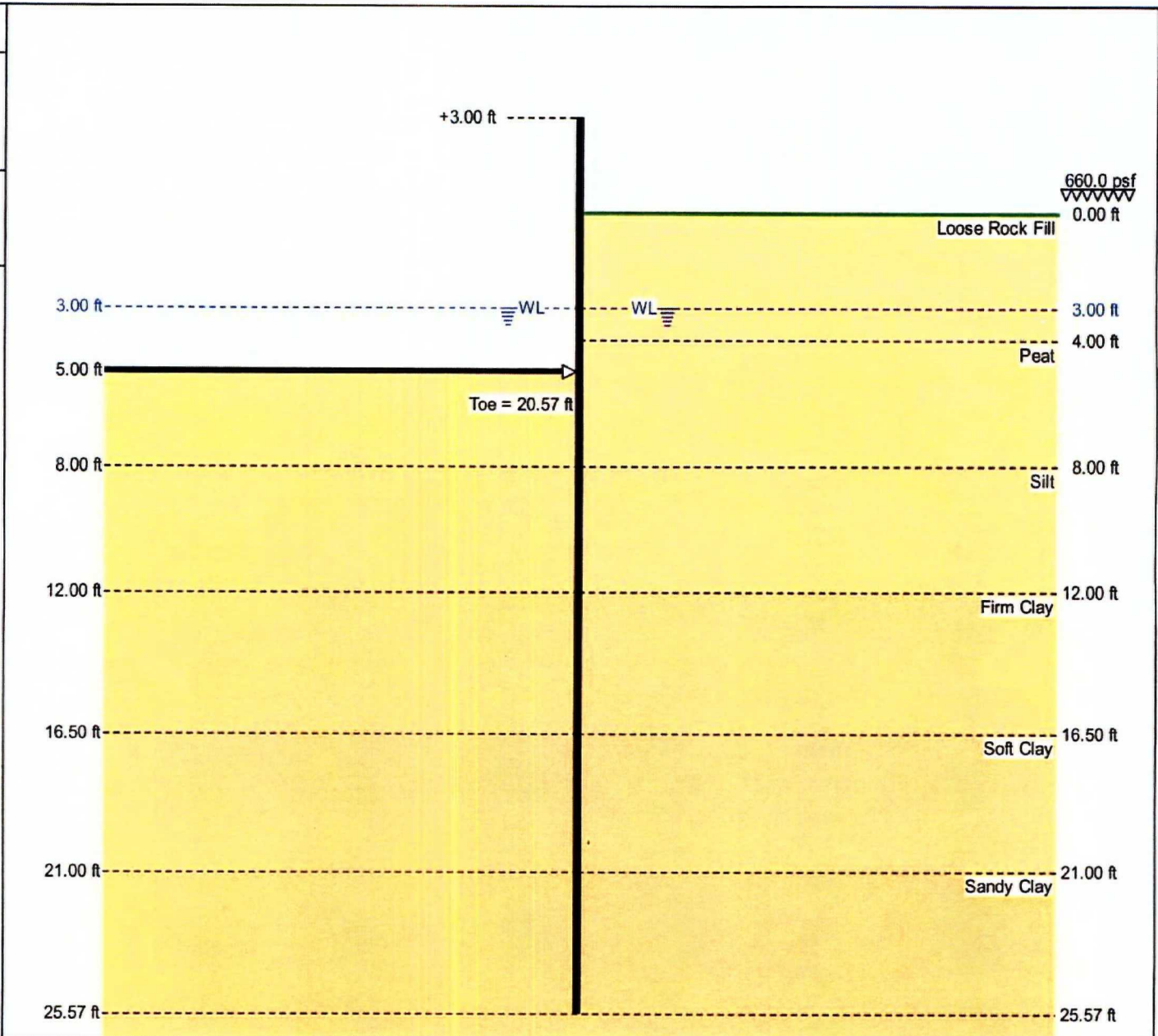
Sheet: Arbed AZ18

Pressure: Coulomb

FOS: 1.0

Toe: Cantilever

216 Paterson Plank Road Site,
Carlstadt, Bergen County, New Jersey
Project No.: 943-6222



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27 4.96

Client: 216 Paterson Plank Road
Cooperating PRP Group

Title: Sheet Pile Wall Design Section
at RD-1

Designer: David Kun Li

Page: 2

Date: 9.13.06

Sheet: Arbed AZ18

Pressure: Coulomb

FOS: 1.0

Toe: Cantilever

216 Paterson Plank Road Site,
Carlstadt, Bergen County, New Jersey
Project No.: 943-6222

Input Data

Depth Of Excavation = 5.00 ft Depth Of Active Water = 3.00 ft
Surcharge = 660.0 psf Depth Of Passive Water = 3.00 ft

Water Density = 62.37 pcf
Minimum Fluid Density = 31.82 pcf

Soil Profile

Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}
0.00	Loose Rock Fill	120.00	57.60	0.0	0.0	33.0	16.5	0.27	0.00	6.24	0.00
4.00	Peat	80.00	17.60	100.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00
8.00	Silt	110.00	47.60	200.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00
12.00	Firm Clay	120.00	57.60	600.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00
16.50	Soft Clay	115.00	52.60	400.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00
21.00	Sandy Clay	120.00	57.60	200.0	0.0	28.0	14.0	0.33	1.14	4.33	4.16

Solution

Sheet

Sheet Name	I (in ⁴ /ft)	E (psi)	Z (in ³ /ft)	f (psi)	Maximum Bending Moment (ftlb/ft)	Upstand (ft)	Toe (ft)	Pile Length (ft)
Arbed AZ18	250.40	3.04E+07	33.50	25000.0	69708.5	3.00	20.57	28.57

Maxima

	Maximum	Depth
Pressure	895.2 psf	5.00 ft

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Client: 216 Paterson Plank Road
Cooperating PRP Group

Title: Sheet Pile Wall Design Section
at RD-1

Designer: David Kun Li

Page: 3

Date: 9.13.06

Sheet: Arbed AZ18

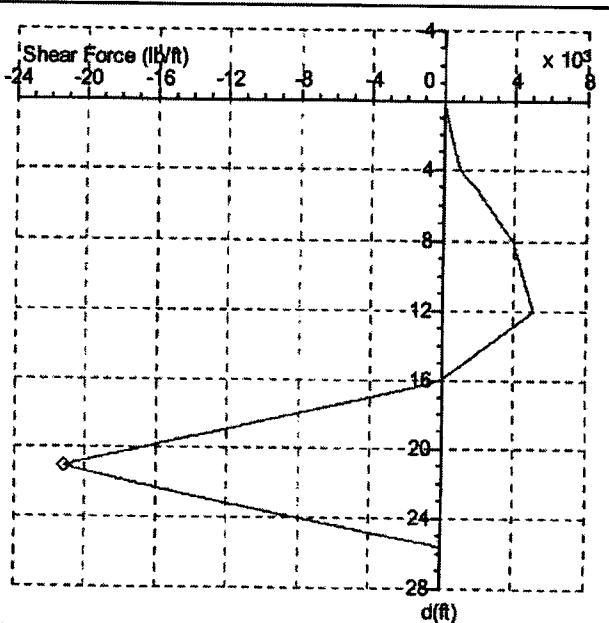
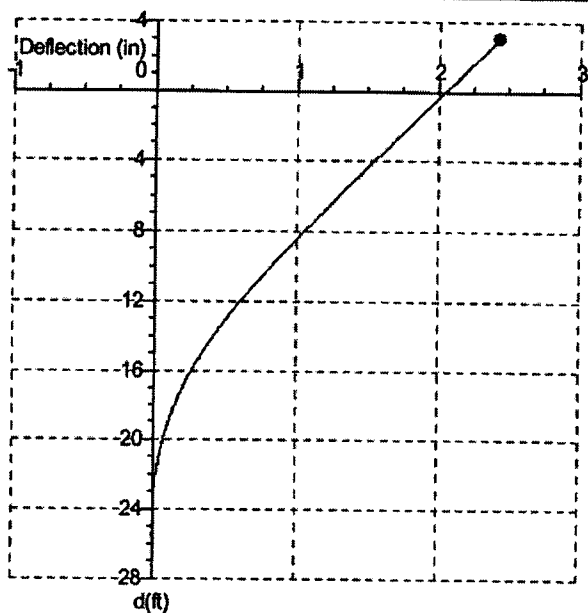
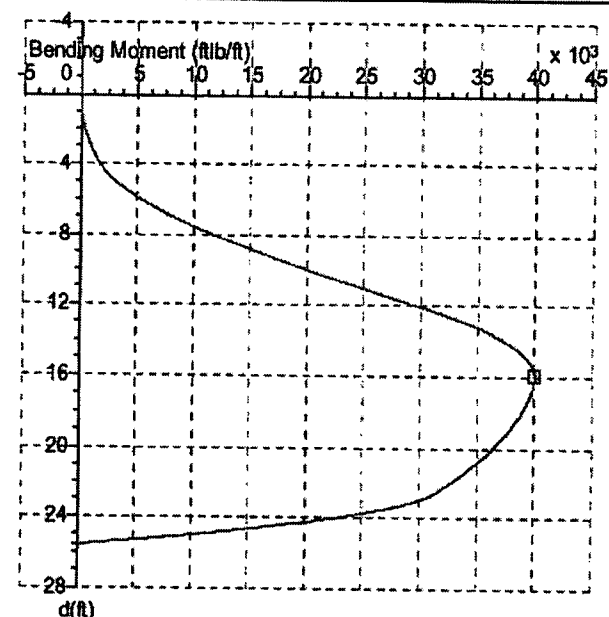
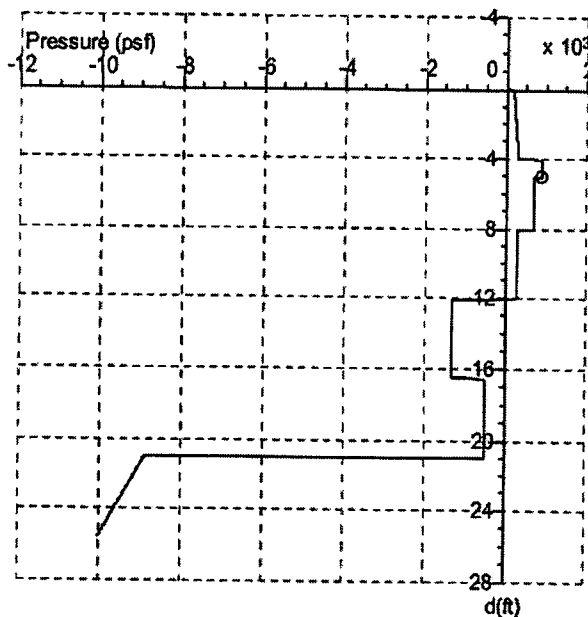
Pressure: Coulomb

FOS: 1.0

Toe: Cantilever

	Maximum	d (ft)
○	895.2 psf	5.00
□	40054.3 ft/lb/ft	15.95
◇	21180.9 lb/ft	21.04
●	2.4 in	-3.00

216 Paterson Plank Road Site,
Carlstadt, Bergen County, New Jersey
Project No.: 943-6222



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06
No
b1

Client: 216 Paterson Plank Road Cooperating PRP Group																	
Title: Sheet Pile Wall Design Section at RD-1 Designer: David Kun Li Page: 4 Date: 9.13.06																	
Sheet: Arbed AZ18 Pressure: Coulomb FOS: 1.0 Toe: Cantilever																	
216 Paterson Plank Road Site, Carlstadt, Bergen County, New Jersey Project No.: 943-6222																	
depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)		depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)		depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	
0.00	179.0	0.0	2.0	4.3		8.60	295.2	14279.2	1.0	4119.4		17.20	-504.8	39495.2	0.2	-4868.0	
0.23	185.9	4.6	2.0	43.4		8.82	295.2	15167.8	1.0	4182.6		17.42	-504.8	39329.3	0.2	-5784.9	
0.45	193.6	19.8	2.0	88.7		9.05	295.2	16171.1	0.9	4252.9		17.65	-504.8	39149.4	0.2	-6803.7	
0.68	200.6	42.8	2.0	131.0		9.28	295.2	17088.3	0.9	4316.1		17.87	-504.8	38955.5	0.2	-7720.7	
0.91	208.3	79.1	1.9	179.7		9.50	295.2	18123.3	0.9	4386.4		18.10	-504.8	38716.8	0.1	-8739.5	
1.13	215.2	121.9	1.9	225.2		9.73	295.2	19069.1	0.9	4449.7		18.33	-504.8	38492.8	0.1	-9656.4	
1.36	222.9	181.1	1.9	277.4		9.96	295.2	20135.9	0.8	4520.0		18.55	-504.8	38219.7	0.1	-10675.2	
1.58	229.9	245.2	1.9	326.0		10.18	295.2	21110.3	0.8	4583.2		18.78	-504.8	37965.7	0.1	-11592.2	
1.81	237.6	328.7	1.8	381.7		10.41	295.2	22208.9	0.8	4653.5		19.01	-504.8	37697.8	0.1	-12611.0	
2.04	244.5	415.4	1.8	433.5		10.63	295.2	23211.9	0.8	4716.7		19.23	-504.8	37415.7	0.1	-13527.9	
2.26	252.2	524.9	1.8	492.7		10.86	295.2	24342.2	0.7	4787.0		19.46	-504.8	37076.3	0.1	-14546.7	
2.49	259.2	635.6	1.7	547.5		11.09	295.2	25373.8	0.7	4850.3		19.68	-504.8	36764.3	0.1	-15463.6	
2.72	266.9	772.7	1.7	610.3		11.31	295.2	26536.0	0.7	4920.6		19.91	-504.8	36390.5	0.1	-16482.4	
2.94	273.8	908.9	1.7	668.3		11.54	295.2	27596.2	0.7	4983.8		20.14	-504.8	36048.4	0.1	-17399.3	
3.17	278.3	1075.0	1.7	734.1		11.77	295.2	28790.1	0.6	5054.1		20.36	-504.8	35692.3	0.1	-18418.1	
3.39	281.7	1238.0	1.6	794.1		11.99	295.2	29879.0	0.6	5117.3		20.59	-504.8	35322.2	0.1	-19335.0	
3.62	285.4	1434.3	1.6	861.7		12.22	-1304.8	31068.3	0.6	4826.9		20.82	-504.8	34882.0	0.0	-20353.8	
3.85	288.7	1624.7	1.6	923.2		12.44	-1304.8	32075.8	0.6	4547.3		21.04	-8906.5	34481.9	0.0	-21180.9	
4.07	879.3	1853.4	1.5	1041.1		12.67	-1304.8	33125.1	0.5	4236.7		21.27	-8965.8	34007.4	0.0	-20193.3	
4.30	883.0	2094.4	1.5	1230.0		12.90	-1304.8	34006.2	0.5	3957.2		21.49	-9019.3	33577.3	0.0	-19292.4	
4.53	887.2	2409.8	1.5	1440.7		13.12	-1304.8	34914.9	0.5	3646.6		21.72	-9078.7	33133.1	0.0	-18278.0	
4.75	891.0	2736.6	1.5	1631.3		13.35	-1304.8	35669.6	0.5	3367.1		21.95	-9132.1	32674.9	0.0	-17352.9	
4.98	895.2	3147.7	1.4	1843.9		13.58	-1304.8	36437.8	0.5	3056.5		22.17	-9191.5	32134.0	0.0	-16311.6	
5.20	695.2	3557.4	1.4	1995.3		13.80	-1304.8	37066.1	0.4	2776.9		22.40	-9244.9	31645.8	0.0	-15362.4	
5.43	695.2	4050.1	1.4	2160.8		14.03	-1304.8	37693.8	0.4	2466.3		22.63	-9304.3	31033.5	0.0	-14294.3	
5.66	695.2	4527.2	1.3	2309.8		14.25	-1304.8	38195.6	0.4	2186.8		22.85	-9357.7	30266.4	0.0	-13320.9	
5.88	695.2	5094.8	1.3	2475.3		14.48	-1304.8	38682.9	0.4	1876.2		23.08	-9417.1	29250.4	0.0	-12225.9	
6.11	695.2	5639.3	1.3	2624.2		14.71	-1304.8	39058.3	0.4	1596.7		23.30	-9470.5	27984.2	0.0	-11228.3	
6.34	695.2	6281.8	1.3	2789.7		14.93	-1304.8	39405.1	0.3	1286.1		23.53	-9529.9	26229.4	0.0	-10106.5	
6.56	695.2	6893.7	1.2	2938.7		15.16	-1304.8	39654.0	0.3	1006.5		23.76	-9583.3	24423.4	0.0	-9084.7	
6.79	695.2	7610.9	1.2	3104.2		15.39	-1304.8	39860.3	0.3	695.9		23.98	-9642.7	22048.5	0.0	-7936.0	
7.01	695.2	8290.2	1.2	3253.1		15.61	-1304.8	39982.8	0.3	416.4		24.21	-9696.1	19697.4	0.0	-6890.1	
7.24	695.2	9082.4	1.1	3418.6		15.84	-1304.8	40048.7	0.3	105.8		24.44	-9755.5	17090.0	0.0	-5714.6	
7.47	695.2	9829.0	1.1	3567.6		16.06	-1304.8	40048.1	0.3	-349.8		24.66	-9808.9	14225.2	0.0	-4644.5	
7.69	695.2	10696.0	1.1	3733.1		16.29	-1304.8	40008.8	0.3	-1178.2		24.89	-9868.3	10634.5	0.0	-3442.1	
7.92	695.2	11510.0	1.1	3882.0		16.52	-937.6	39933.3	0.2	-1923.7		25.11	-9921.8	7214.4	0.0	-2347.9	
8.15	295.2	12447.8	1.0	3985.8		16.74	-504.8	39803.5	0.2	-2932.2		25.34	-9981.1	2986.0	0.0	-1118.6	
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Client: 216 Paterson Plank Road
Cooperating PRP Group

Title: Sheet Pile Wall Design Section
at RD-1-10% Slope

Designer: David Kun Li

Page: 1

Date: 9.13.06

Sheet: Arbed AZ18

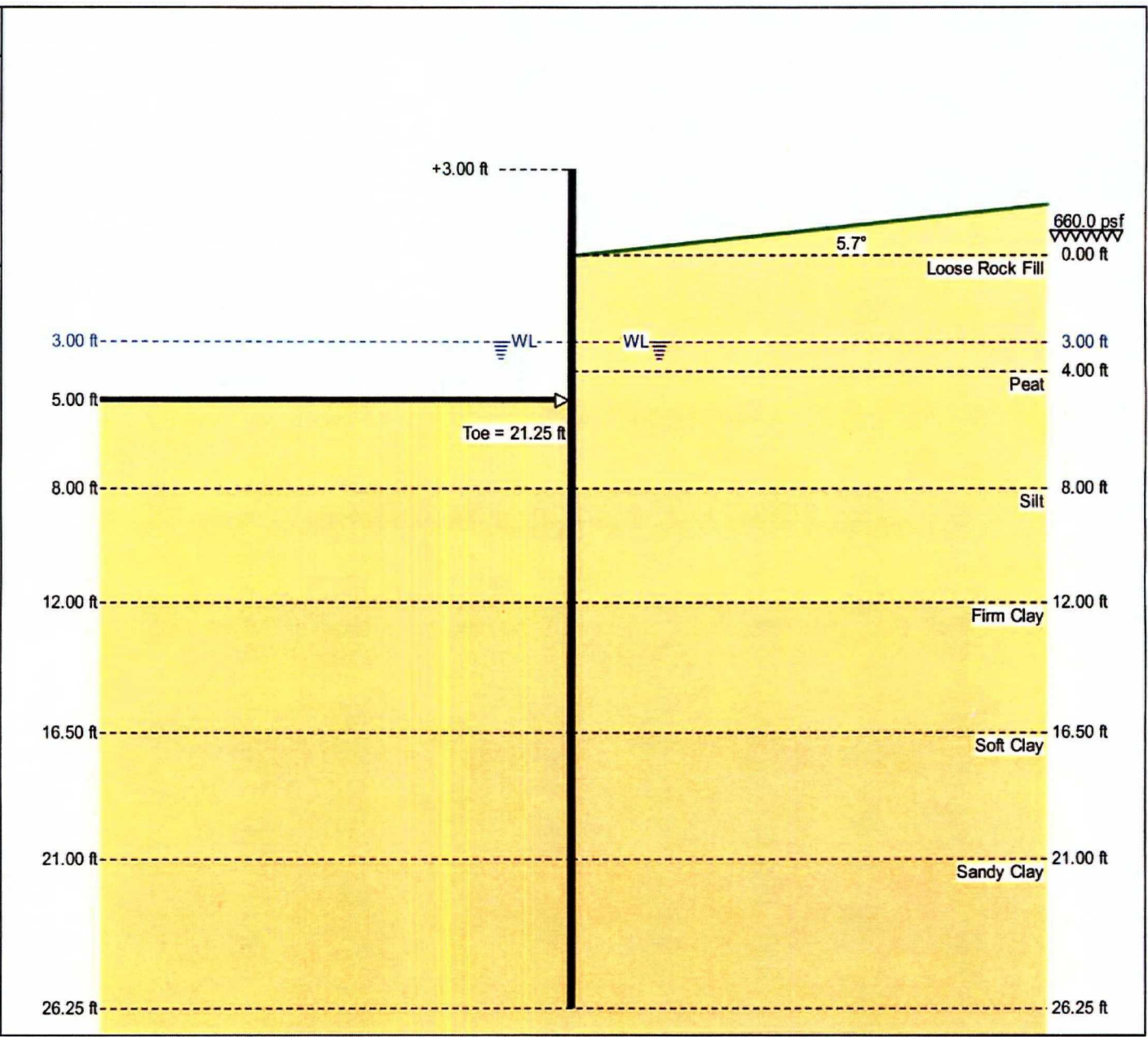
Pressure: Coulomb

FOS: 1.0

Toe: Cantilever

216 Paterson Plank Road Site,
Carlstadt, Bergen County, New Jersey

Project No.: 943-6222



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01 of 15

<p>Client: 216 Paterson Plank Road Cooperating PRP Group</p> <p>Title: Sheet Pile Wall Design Section at RD-1-10% Slope</p> <p>Designer: David Kun Li</p> <p>Page: 2</p> <p>Date: 9.13.06</p> <p>Sheet: Arbed AZ18</p> <p>Pressure: Coulomb</p> <p>FOS: 1.0</p> <p>Toe: Cantilever</p> <p>216 Paterson Plank Road Site, Carlstadt, Bergen County, New Jersey</p> <p>Project No.: 943-6222</p>	<div style="text-align: right; margin-bottom: 10px;"><u>Input Data</u></div> <p>Depth Of Excavation = 5.00 ft Depth Of Active Water = 3.00 ft Water Density = 62.37 pcf</p> <p>Surcharge = 660.0 psf Depth Of Passive Water = 3.00 ft Minimum Fluid Density = 31.82 pcf</p> <p>Slope (active) = 5.7 degrees</p> <p><u>Soil Profile</u></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Depth (ft)</th> <th>Soil Name</th> <th>γ (pcf)</th> <th>γ' (pcf)</th> <th>C (psf)</th> <th>C_u (psf)</th> <th>ϕ (°)</th> <th>δ (°)</th> <th>K_a</th> <th>K_{ac}</th> <th>K_p</th> <th>K_{pc}</th> </tr> </thead> <tbody> <tr> <td>0.00</td> <td>Loose Rock Fill</td> <td>120.00</td> <td>57.60</td> <td>0.0</td> <td>0.0</td> <td>33.0</td> <td>16.5</td> <td>0.27</td> <td>0.00</td> <td>6.24</td> <td>0.00</td> </tr> <tr> <td>4.00</td> <td>Peat</td> <td>80.00</td> <td>17.60</td> <td>100.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>1.00</td> <td>2.00</td> <td>1.00</td> <td>2.00</td> </tr> <tr> <td>8.00</td> <td>Silt</td> <td>110.00</td> <td>47.60</td> <td>200.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>1.00</td> <td>2.00</td> <td>1.00</td> <td>2.00</td> </tr> <tr> <td>12.00</td> <td>Firm Clay</td> <td>120.00</td> <td>57.60</td> <td>600.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>1.00</td> <td>2.00</td> <td>1.00</td> <td>2.00</td> </tr> <tr> <td>16.50</td> <td>Soft Clay</td> <td>115.00</td> <td>52.60</td> <td>400.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>1.00</td> <td>2.00</td> <td>1.00</td> <td>2.00</td> </tr> <tr> <td>21.00</td> <td>Sandy Clay</td> <td>120.00</td> <td>57.60</td> <td>200.0</td> <td>0.0</td> <td>28.0</td> <td>14.0</td> <td>0.33</td> <td>1.14</td> <td>4.33</td> <td>4.16</td> </tr> </tbody> </table> <div style="text-align: right; margin-top: 10px;"><u>Solution</u></div> <p><u>Sheet</u></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Sheet Name</th> <th>I (in⁴/ft)</th> <th>E (psi)</th> <th>Z (in³/ft)</th> <th>f (psi)</th> <th>Maximum Bending Moment (ftlb/ft)</th> <th>Upstand (ft)</th> <th>Toe (ft)</th> <th>Pile Length (ft)</th> </tr> </thead> <tbody> <tr> <td>Arbed AZ18</td> <td>250.40</td> <td>3.04E+07</td> <td>33.50</td> <td>25000.0</td> <td>69708.5</td> <td>3.00</td> <td>21.25</td> <td>29.25</td> </tr> </tbody> </table> <p><u>Maxima</u></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Maximum</th> <th>Depth</th> </tr> </thead> <tbody> <tr> <td>Pressure</td> <td>953.4 psf</td> <td>5.00 ft</td> </tr> </tbody> </table>	Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_u (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}	0.00	Loose Rock Fill	120.00	57.60	0.0	0.0	33.0	16.5	0.27	0.00	6.24	0.00	4.00	Peat	80.00	17.60	100.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00	8.00	Silt	110.00	47.60	200.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00	12.00	Firm Clay	120.00	57.60	600.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00	16.50	Soft Clay	115.00	52.60	400.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00	21.00	Sandy Clay	120.00	57.60	200.0	0.0	28.0	14.0	0.33	1.14	4.33	4.16	Sheet Name	I (in ⁴ /ft)	E (psi)	Z (in ³ /ft)	f (psi)	Maximum Bending Moment (ftlb/ft)	Upstand (ft)	Toe (ft)	Pile Length (ft)	Arbed AZ18	250.40	3.04E+07	33.50	25000.0	69708.5	3.00	21.25	29.25		Maximum	Depth	Pressure	953.4 psf	5.00 ft
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06/25

Client: 216 Paterson Plank Road
Cooperating PRP Group

Title: Sheet Pile Wall Design Section
at RD-1-10% Slope

Designer: David Kun Li

Page: 3

Date: 9.13.06

Sheet: Arbed AZ18

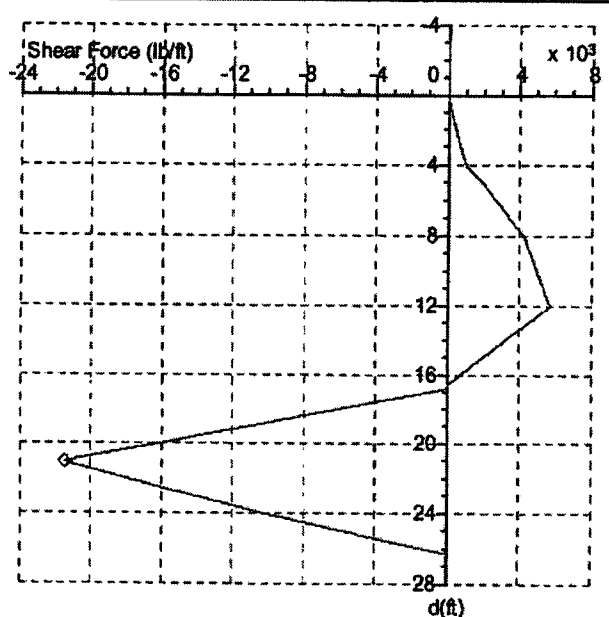
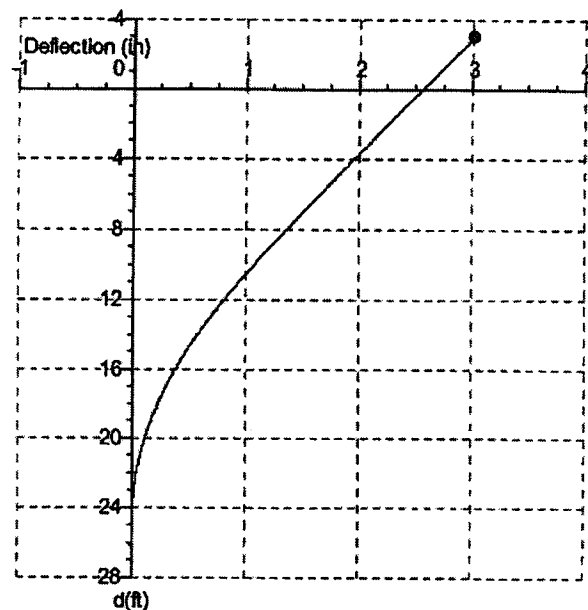
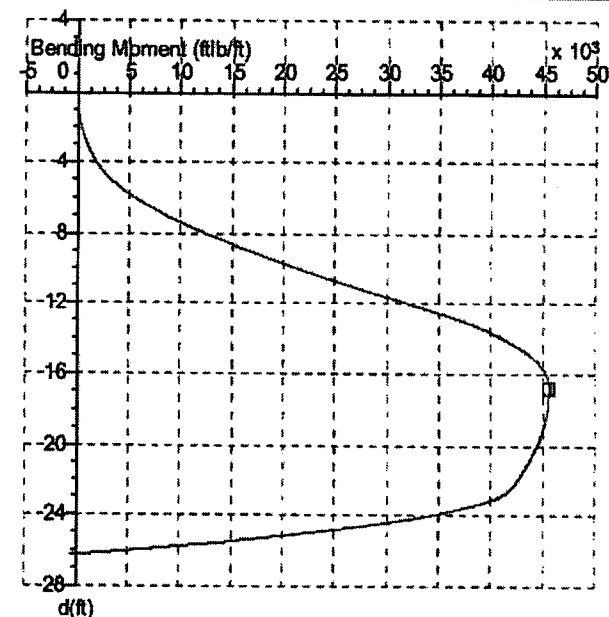
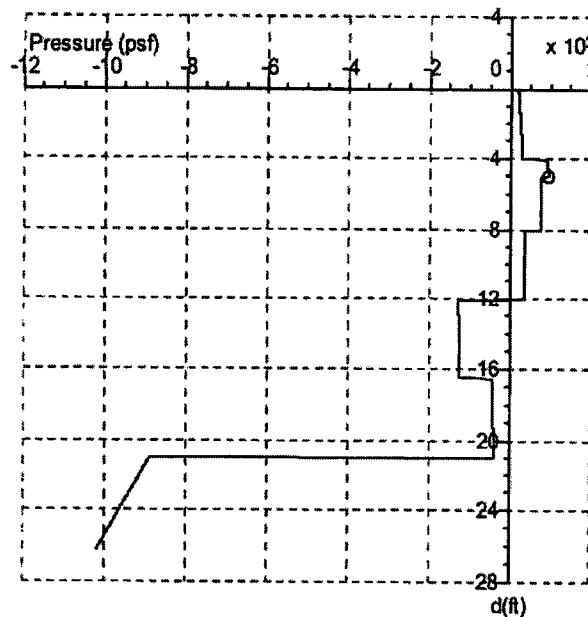
Pressure: Coulomb

FOS: 1.0

Toe: Cantilever

	Maximum	d (ft)
○	953.4 psf	5.00
□	45592.8 ftlb/ft	16.74
◇	21461.0 lb/ft	21.03
●	3.0 in	-3.00

216 Paterson Plank Road Site,
Carlstadt, Bergen County, New Jersey
Project No.: 943-6222



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Client: 216 Paterson Plank Road
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Page: 4

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Sheet: Arbed AZ18

Pressure: Coulomb

FOS: 1.0

Toe: Cantilever

216 Paterson Plank Road Site,
Carlstadt, Bergen County, New Jersey

Project No.: 943-6222

depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)
0.00	189.1	0.0	2.6	4.6	8.83	361.0	16302.6	1.2	4545.3	17.65	-403.6	45496.7	0.3	-4541.1
0.23	196.6	5.1	2.5	47.0	9.06	362.3	17307.3	1.2	4624.7	17.88	-402.2	45443.2	0.2	-5645.0
0.46	205.0	21.9	2.5	96.0	9.29	363.9	18444.1	1.2	4713.2	18.12	-400.6	45377.8	0.2	-6871.8
0.70	212.5	47.4	2.5	141.9	9.52	365.2	19485.7	1.1	4793.1	18.35	-399.2	45300.8	0.2	-7976.3
0.93	220.8	87.8	2.4	194.8	9.76	366.8	20663.6	1.1	4882.4	18.58	-397.6	45198.4	0.2	-9203.9
1.16	228.3	135.3	2.4	244.2	9.99	368.1	21742.4	1.1	4963.0	18.81	-396.0	45096.3	0.2	-10431.9
1.39	236.7	201.0	2.3	300.9	10.22	369.7	22961.8	1.0	5052.9	19.05	-394.5	44982.6	0.2	-11537.4
1.63	244.2	272.1	2.3	353.8	10.45	371.0	24078.0	1.0	5134.1	19.28	-392.9	44838.4	0.2	-12766.1
1.86	252.5	364.9	2.3	414.4	10.68	372.6	25339.2	1.0	5224.8	19.51	-391.5	44720.4	0.1	-13872.3
2.09	260.1	461.3	2.2	470.7	10.92	374.1	26622.6	1.0	5315.8	19.74	-389.9	44549.8	0.1	-15101.8
2.32	268.4	583.0	2.2	535.2	11.15	375.5	27796.6	0.9	5398.0	19.97	-388.5	44388.3	0.1	-16208.7
2.55	275.9	706.2	2.2	595.0	11.38	377.0	29122.3	0.9	5489.7	20.21	-386.9	44215.3	0.1	-17438.9
2.79	284.3	858.7	2.1	663.4	11.61	378.4	30334.5	0.9	5572.6	20.44	-385.4	44030.9	0.1	-18546.4
3.02	291.4	1010.3	2.1	726.6	11.85	379.9	31702.7	0.8	5665.0	20.67	-383.8	43806.1	0.1	-19777.4
3.25	295.4	1195.3	2.1	798.2	12.08	-1264.3	32949.5	0.8	5614.2	20.90	-382.4	43627.9	0.1	-20885.6
3.48	299.4	1397.7	2.0	870.7	12.31	-1262.6	34284.0	0.8	5306.3	21.14	-8933.6	43377.2	0.1	-21037.0
3.72	303.0	1595.1	2.0	938.8	12.54	-1261.1	35421.0	0.7	5029.6	21.37	-8988.3	43145.8	0.1	-20264.4
3.95	307.0	1831.6	2.0	1011.2	12.77	-1259.4	36613.1	0.7	4722.4	21.60	-9049.1	42903.1	0.1	-19391.9
4.18	935.4	2068.9	1.9	1192.2	13.01	-1257.9	37622.0	0.7	4446.4	21.83	-9103.8	42649.2	0.0	-18594.0
4.41	940.8	2384.5	1.9	1420.9	13.24	-1256.3	38672.1	0.7	4140.0	22.07	-9164.6	42345.4	0.0	-17693.4
4.65	945.7	2716.3	1.9	1627.8	13.47	-1254.8	39553.3	0.6	3864.7	22.30	-9219.3	42107.9	0.0	-16870.1
4.88	951.1	3138.4	1.8	1859.0	13.70	-1253.1	40461.7	0.6	3559.1	22.53	-9280.1	41744.2	0.0	-15941.3
5.11	753.9	3565.6	1.8	2046.5	13.94	-1251.6	41215.6	0.6	3284.4	22.76	-9340.9	41188.7	0.0	-14997.7
5.34	755.0	4084.5	1.8	2230.4	14.17	-1249.9	41982.6	0.6	2979.6	22.99	-9395.6	40372.2	0.0	-14135.8
5.57	756.0	4589.9	1.7	2396.1	14.40	-1248.4	42609.5	0.5	2705.6	23.23	-9456.4	39118.1	0.0	-13164.1
5.81	757.1	5194.1	1.7	2580.5	14.63	-1246.8	43235.6	0.5	2401.6	23.46	-9511.1	37738.4	0.0	-12276.8
6.04	758.1	5776.3	1.6	2746.7	14.86	-1245.1	43787.6	0.5	2098.0	23.69	-9571.9	36094.0	0.0	-11276.9
6.27	759.2	6466.0	1.6	2931.6	15.10	-1243.6	44221.1	0.5	1825.1	23.92	-9626.6	34183.5	0.0	-10364.3
6.50	760.2	7125.2	1.6	3098.3	15.33	-1241.9	44632.7	0.4	1522.2	24.16	-9687.4	32005.7	0.0	-9336.3
6.74	761.4	7900.6	1.5	3283.7	15.56	-1240.4	44940.1	0.4	1250.0	24.39	-9742.1	29559.5	0.0	-8398.4
6.97	762.4	8637.2	1.5	3450.8	15.79	-1238.8	45211.6	0.4	947.9	24.62	-9802.9	26433.4	0.0	-7342.2
7.20	763.5	9498.6	1.5	3636.8	16.03	-1237.3	45393.0	0.4	676.4	24.85	-9857.6	23407.6	0.0	-6379.0
7.43	764.6	10405.3	1.4	3823.0	16.26	-1235.6	45524.8	0.4	375.1	25.08	-9918.4	20109.5	0.0	-5294.6
7.66	765.6	11260.2	1.4	3990.8	16.49	-1234.1	45580.7	0.3	104.2	25.32	-9973.1	16537.7	0.0	-4306.0
7.90	766.7	12253.3	1.4	4177.5	16.72	-409.7	45592.8	0.3	-6.5	25.55	-10033.8	12691.3	0.0	-3193.6
8.13	356.5	13183.0	1.3	4291.7	16.96	-408.3	45588.2	0.3	-986.5	25.78	-10088.6	8568.7	0.0	-2179.7
8.36	358.1	14238.5	1.3	4378.8	17.19	-406.7	45568.5	0.3	-2211.8	26.01	-10149.3	3517.7	0.0	-1039.0
8.59	359.4	15206.6	1.3	4457.5	17.42	-405.2	45538.5	0.3	-3315.0	26.25	-10198.0	-509.4	0.0	0.0

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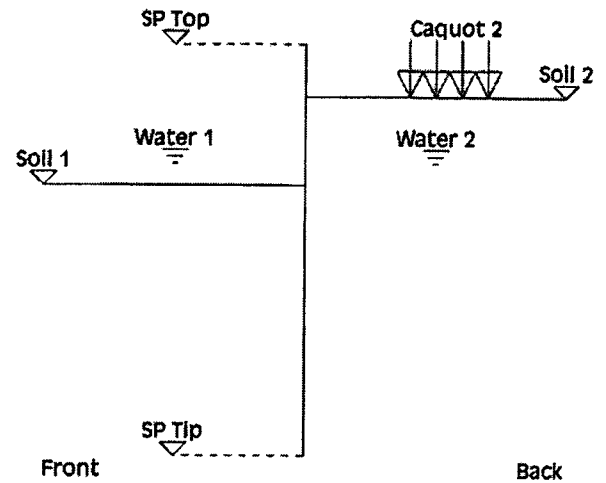
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Sheet Pile Design According to Blum-Method

Project Name: Sheet Pile Wall Design at RD-2
Date: 9/12/2006
Author: DKL
Company:
Comment:

Geodata

	Unit
Sheet Pile Top Level (ft)	-3.000
Sheet Pile Tip Level (ft)	20.379
Soil Level in Front (ft)	5.000
Soil Level behind (ft)	0.000
Anchor level (ft)	-3.000
Water Level in Front (ft)	3.000
Water Level behind (ft)	3.000
Soil Surface Inclination in Front (Deg)	0.000
Soil Surface Inclination behind (Deg)	0.000
Caquot Surcharge in Front (kip/ft ²)	0.000
Caquot Surcharge behind (kip/ft ²)	0.660
Anchor Inclination (Deg)	0.000
Earth Support	Cantilever



Soil Layers

Layers In Front

	Layer Tip (ft)	Density Moist (kip/ft ³)	Density Submerged (kip/ft ³)	Kph	Phi (Deg)	Delta (Deg)	Cohesion (kip/ft ²)
Layer 1	9.000	0.080	0.018	1.000	0.000	0.000	0.100
Layer 2	13.500	0.120	0.058	1.000	0.000	0.000	0.600
Layer 3	18.000	0.115	0.053	1.000	0.000	0.000	0.400
Layer 4	40.000	0.120	0.058	4.216	28.000	-14.000	0.200

Layers behind

	Layer Tip (ft)	Density Moist (kip/ft ³)	Density Submerged (kip/ft ³)	Kph	Phi (Deg)	Delta (Deg)	Cohesion (kip/ft ²)
Layer 1	5.000	0.120	0.058	0.256	33.000	16.500	0.000
Layer 2	9.000	0.080	0.018	1.000	0.000	0.000	0.100
Layer 3	13.500	0.120	0.058	1.000	0.000	0.000	0.600
Layer 4	18.000	0.115	0.053	1.000	0.000	0.000	0.400
Layer 5	40.000	0.120	0.058	0.317	28.000	14.000	0.200

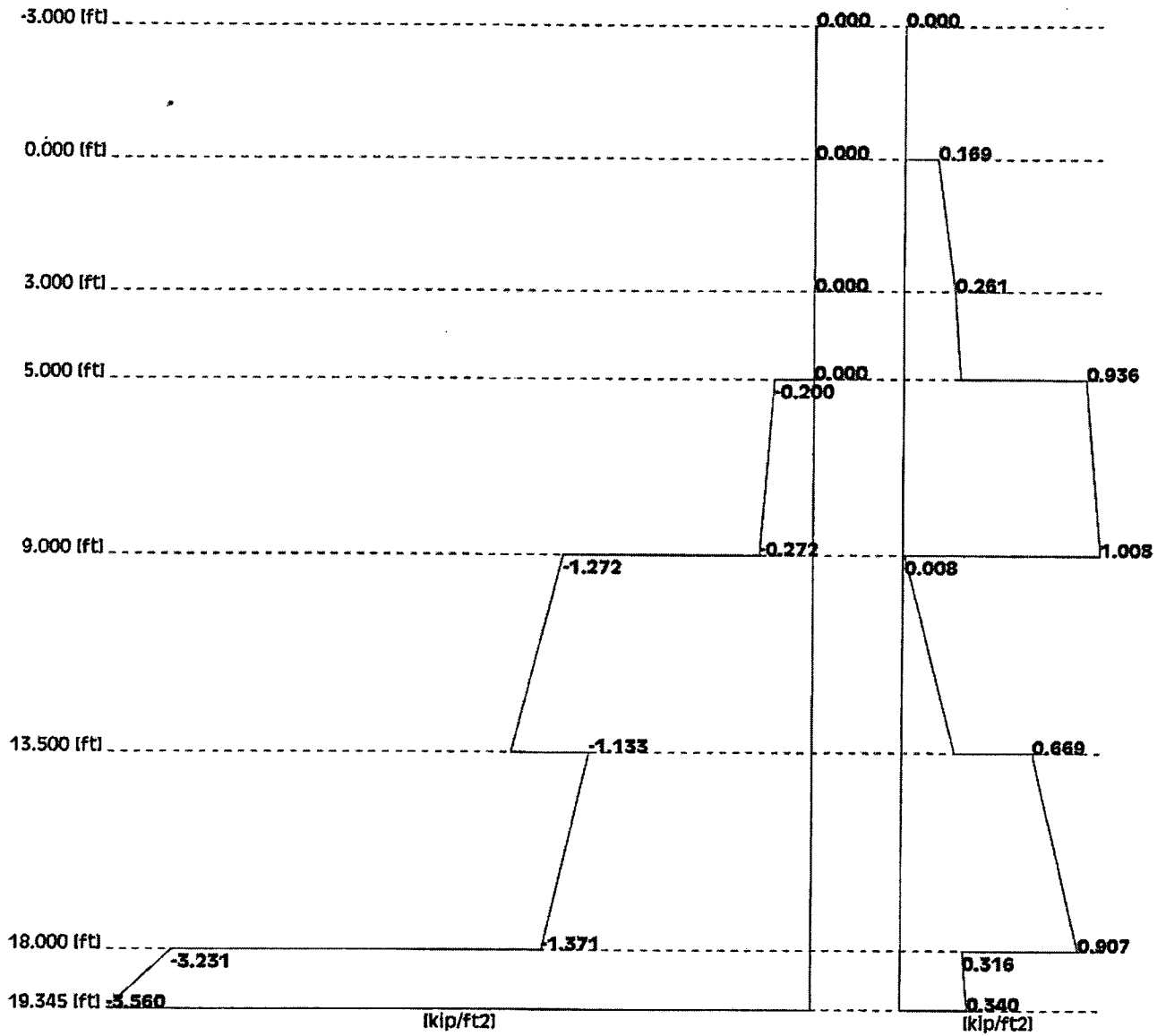
Pile Section

Name	AZ13-1
Inertia (in4/ft)	132.835
Modulus (in3/ft)	22.320
Area (in2/ft)	5.939
Mass (lbs/ft2)	20.215
Steel Grade (lb/in2)	34795.867
Requested Safety	1.500

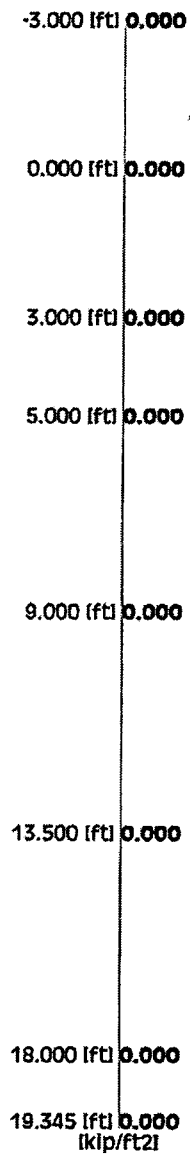
Pile Check

		Depth (ft)
Name	AZ13-1	
Inertia (In4/ft)	132.835	
Modulus (In3/ft)	22.320	
Area (In2/ft)	5.939	
Mass (lbs/ft2)	20.215	
Steel Grade (lb/in2)	34795.867	
Minimal Moment (kip-ft/ft)	-0.282	19.378
Maximal Moment (kip-ft/ft)	20.195	12.281
Normal Forces at Max. Moment (kip/ft)	-0.666	19.378
Normal Forces at Min. Moment (kip/ft)	0.355	12.281
Deflection at Min. Moment (ft)	0.000	19.378
Deflection at Max. Moment (ft)	-0.011	12.281
Min. Stress at Min. Moment (lb/in2)	-263.866	19.378
Max. Stress at Min. Moment (lb/in2)	39.680	19.378
Min. Stress at Max. Moment (lb/in2)	-10799.537	12.281
Max. Stress at Max. Moment (lb/in2)	10919.001	12.281
Safety > Req. Safety = 1.500	3.187	
Sheet Pile Top Level (ft)	-3.000	
Sheet Pile Tip Level (ft)	20.379	
Sheet Pile Length (ft)	23.379	
Included OverLength (ft)	1.034	
Vertical Equilibrium (kip/ft)	1.269	
Anchor Force (horiz.) (kip/ft)	0.000	

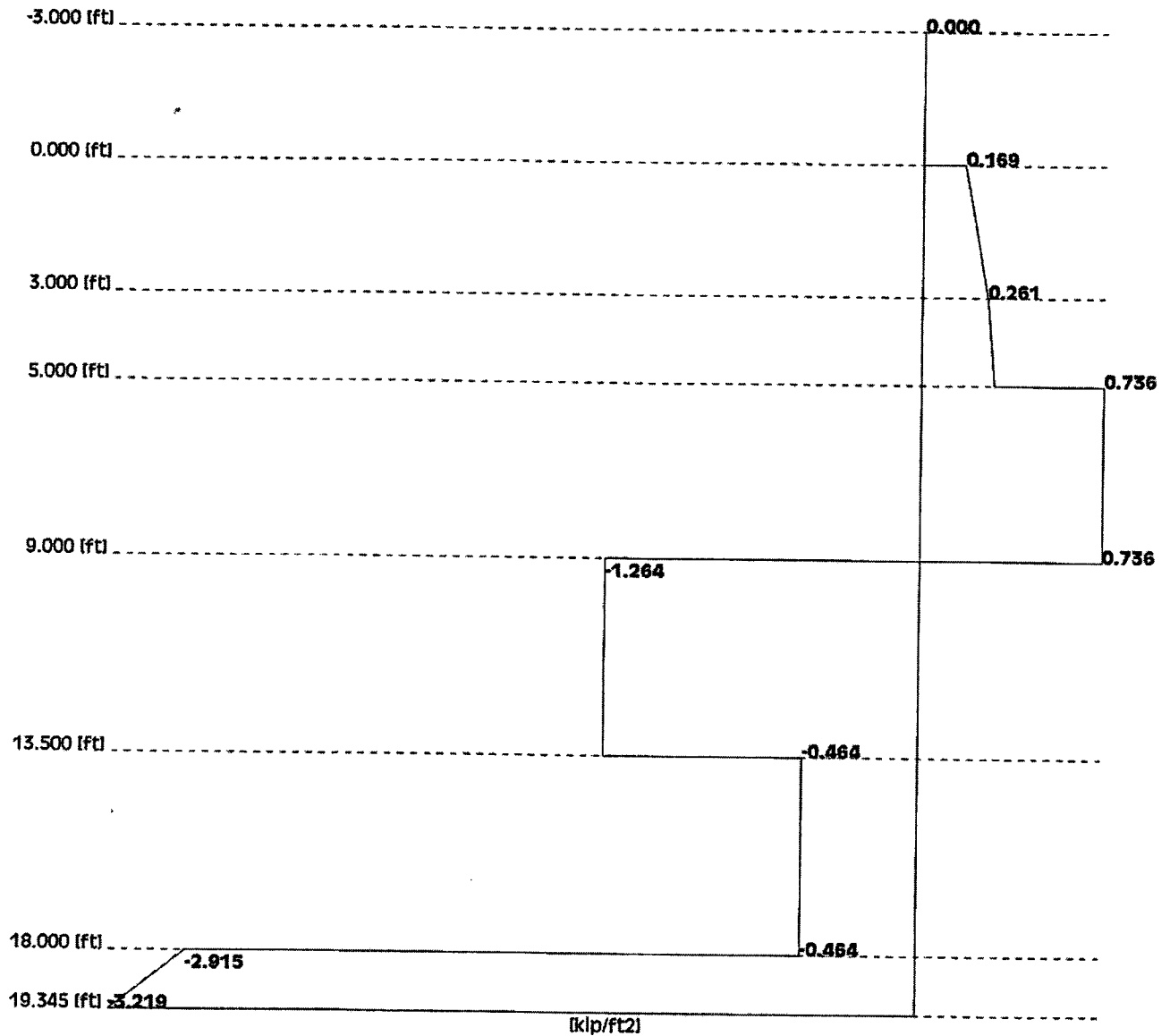
Earth Pressure Diagram



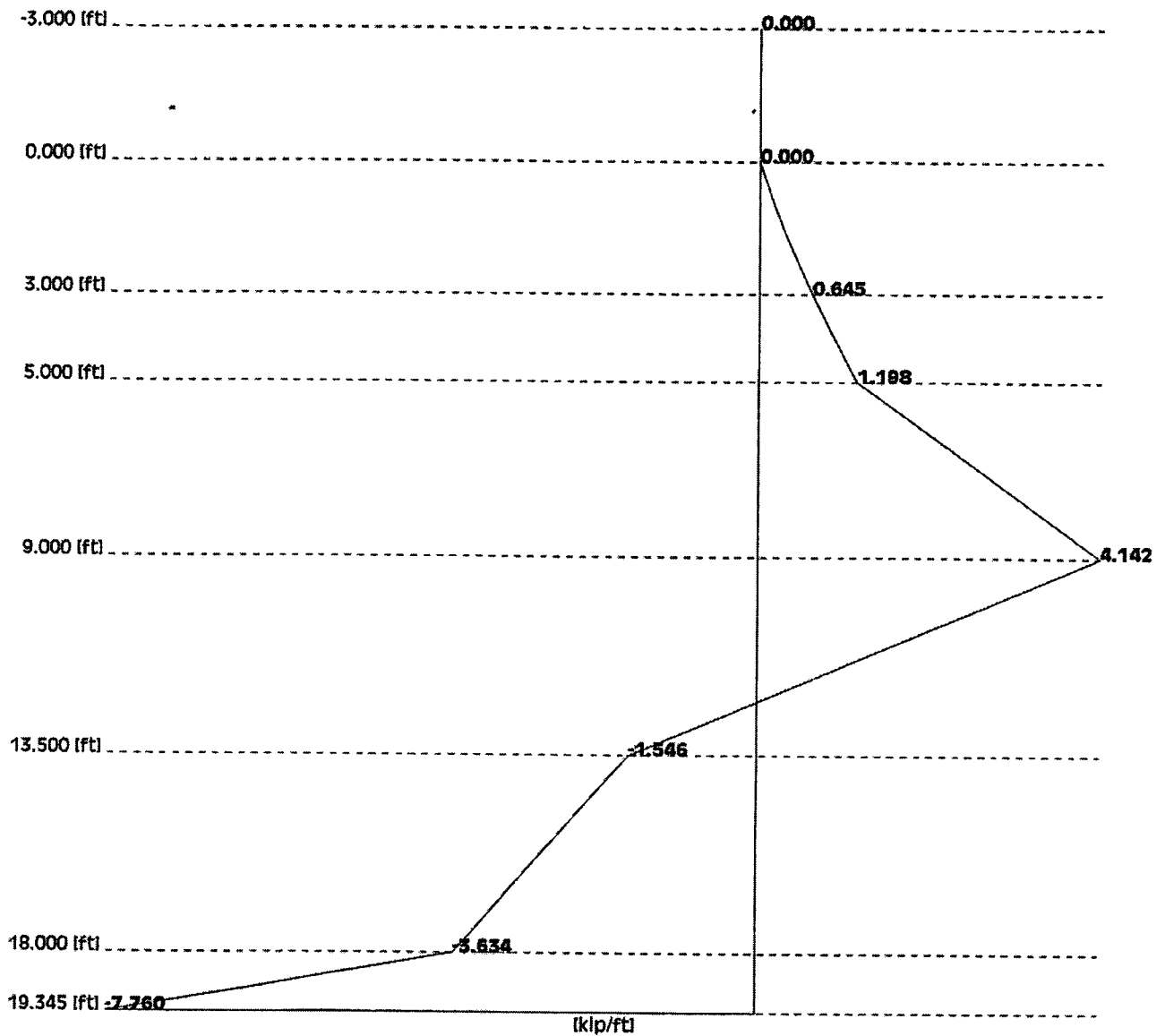
Water Pressure Diagram



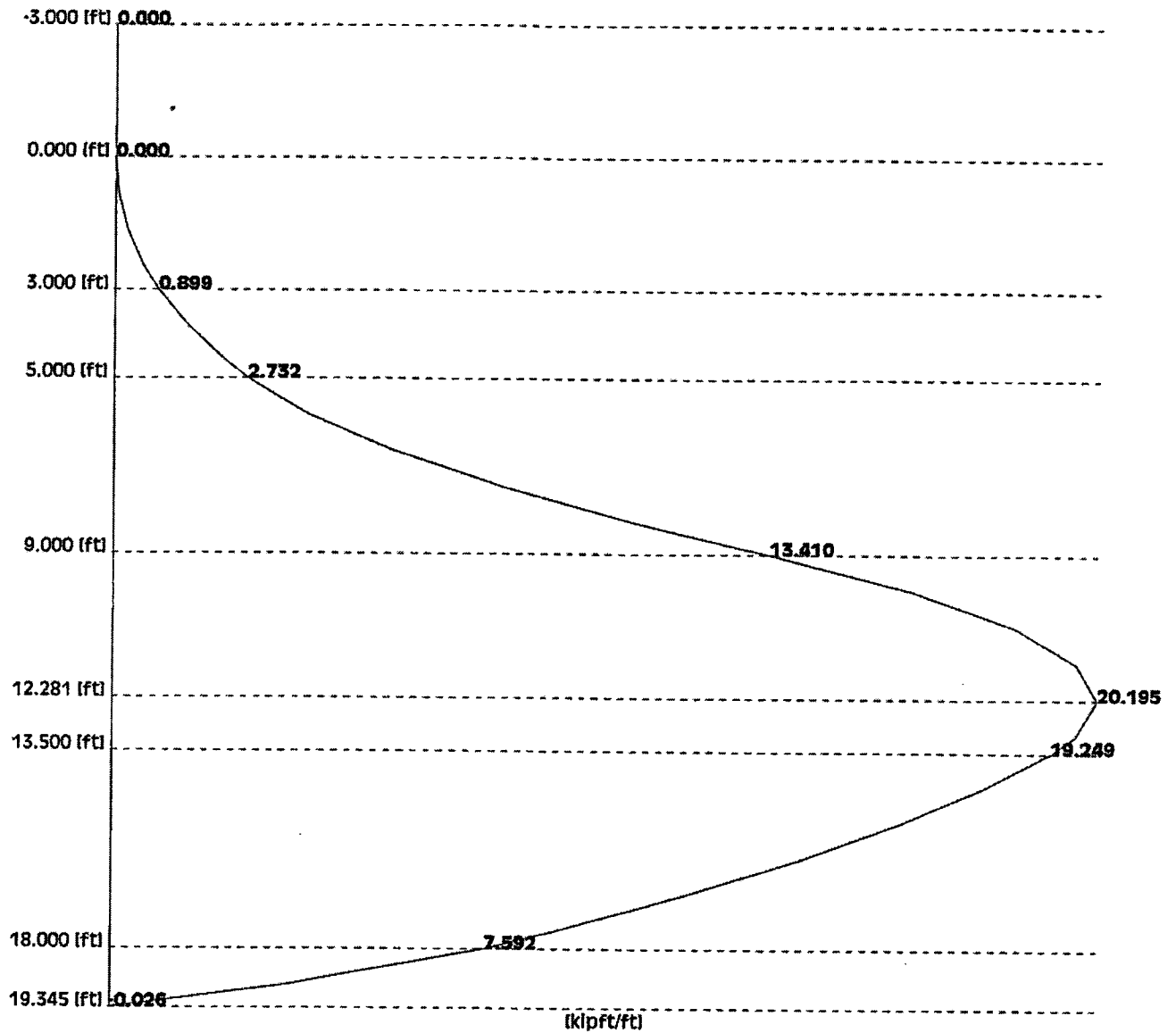
Total Pressure Diagram



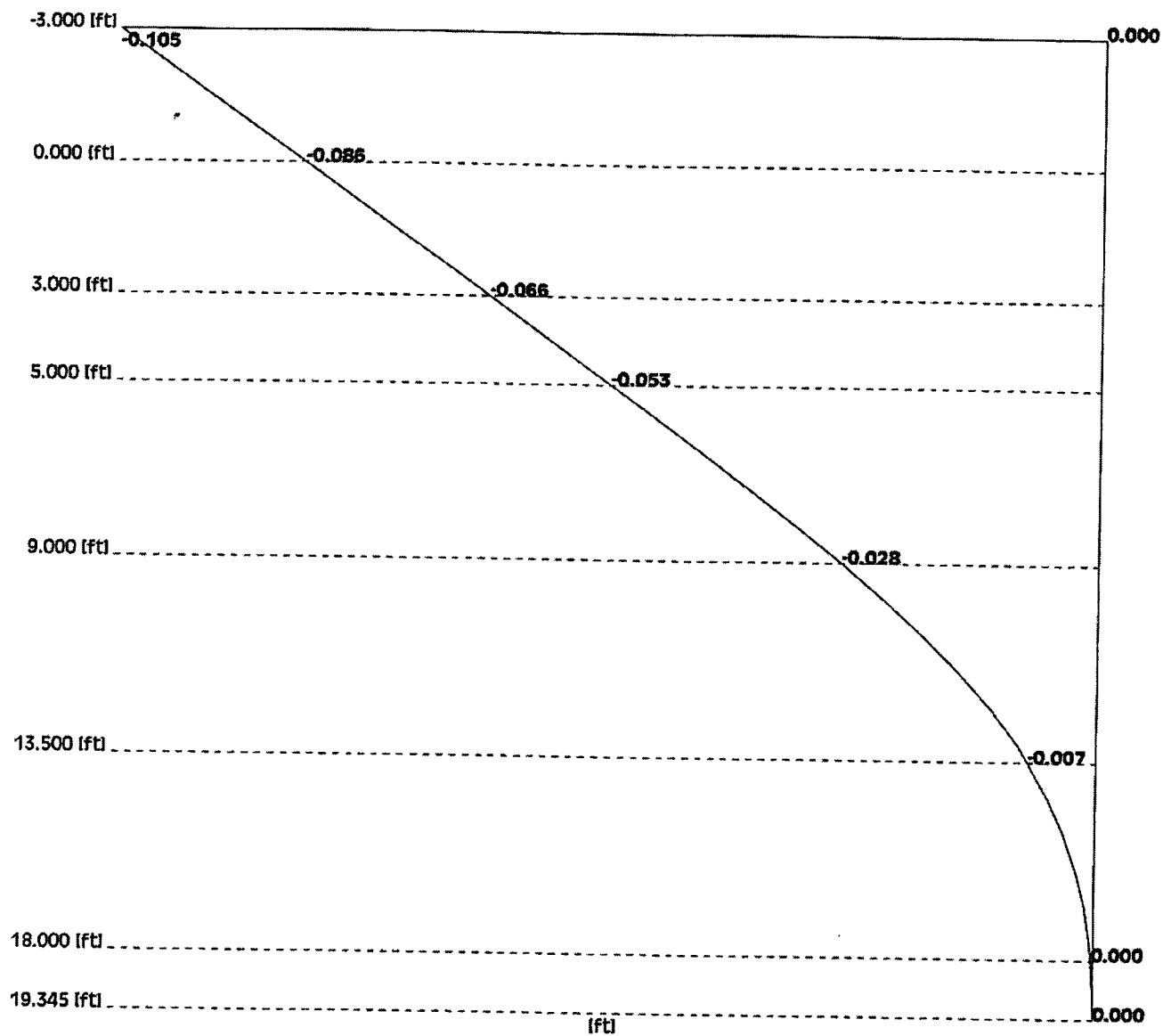
Cross Force Diagram



Moment Diagram



Deflection Diagram



45 / 50

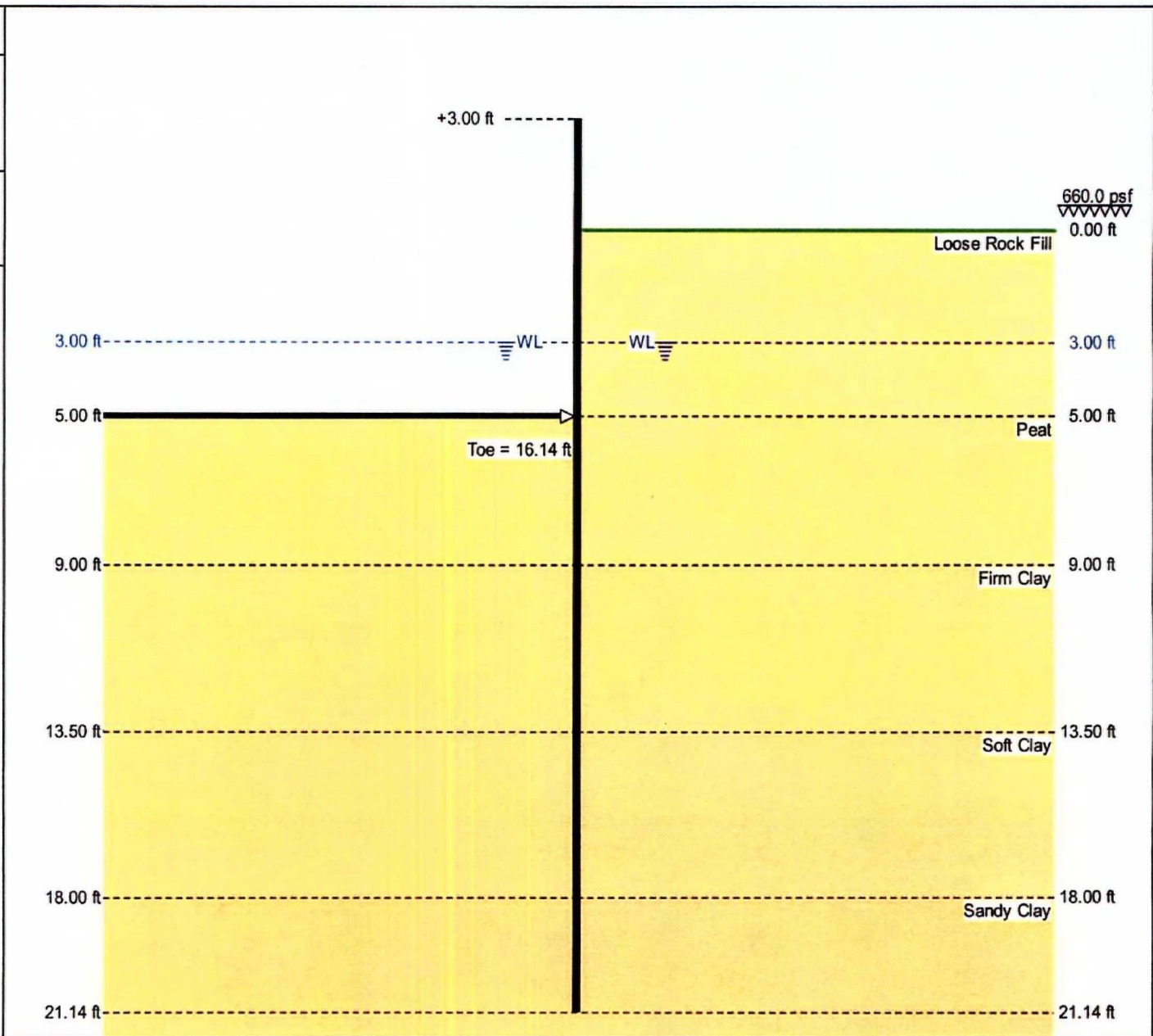
Client: 216 Paterson Plank Road
Cooperating PRP Group

Title: Sheet Pile Wall Design Section
at RD-2

Designer: David Kun Li
Page: 1
Date: 9.13.06

Sheet: Arbed AZ18
Pressure: Coulomb
FOS: 1.0
Toe: Cantilever

216 Paterson Plank Road Site,
Carlstadt, Bergen County, New Jersey
Project No.: 943-6222



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46/40

Client: 216 Paterson Plank Road Cooperating PRP Group Title: Sheet Pile Wall Design Section at RD-2 Designer: David Kun Li Page: 2 Date: 9.13.06 Sheet: Arbed AZ18 Pressure: Coulomb FOS: 1.0 Toe: Cantilever 216 Paterson Plank Road Site, Carlstadt, Bergen County, New Jersey Project No.: 943-6222	<div style="text-align: right; font-weight: bold;">Input Data</div> <div style="display: flex; justify-content: space-between;"> <div> Depth Of Excavation = 5.00 ft Depth Of Active Water = 3.00 ft Surcharge = 660.0 psf Depth Of Passive Water = 3.00 ft </div> <div> Water Density = 62.37 pcf Minimum Fluid Density = 31.82 pcf </div> </div> <div style="margin-top: 10px;"> Soil Profile <table border="1" style="width: 100%; border-collapse: collapse; font-size: 0.9em;"> <thead> <tr> <th>Depth (ft)</th> <th>Soil Name</th> <th>γ (pcf)</th> <th>γ' (pcf)</th> <th>C (psf)</th> <th>C_a (psf)</th> <th>ϕ (°)</th> <th>δ (°)</th> <th>K_a</th> <th>K_{ac}</th> <th>K_p</th> <th>K_{pc}</th> </tr> </thead> <tbody> <tr> <td>0.00</td> <td>Loose Rock Fill</td> <td>120.00</td> <td>57.60</td> <td>0.0</td> <td>0.0</td> <td>33.0</td> <td>16.5</td> <td>0.27</td> <td>0.00</td> <td>6.24</td> <td>0.00</td> </tr> <tr> <td>5.00</td> <td>Peat</td> <td>80.00</td> <td>17.60</td> <td>100.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>1.00</td> <td>2.00</td> <td>1.00</td> <td>2.00</td> </tr> <tr> <td>9.00</td> <td>Firm Clay</td> <td>120.00</td> <td>57.60</td> <td>600.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>1.00</td> <td>2.00</td> <td>1.00</td> <td>2.00</td> </tr> <tr> <td>13.50</td> <td>Soft Clay</td> <td>115.00</td> <td>52.60</td> <td>400.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>1.00</td> <td>2.00</td> <td>1.00</td> <td>2.00</td> </tr> <tr> <td>18.00</td> <td>Sandy Clay</td> <td>120.00</td> <td>57.60</td> <td>200.0</td> <td>0.0</td> <td>28.0</td> <td>14.0</td> <td>0.33</td> <td>1.14</td> <td>4.33</td> <td>4.16</td> </tr> </tbody> </table> </div> <div style="margin-top: 20px; text-align: center;"> Solution </div> <div style="margin-top: 5px;"> Sheet <table border="1" style="width: 100%; border-collapse: collapse; font-size: 0.9em;"> <thead> <tr> <th>Sheet Name</th> <th>I (in⁴/ft)</th> <th>E (psi)</th> <th>Z (in³/ft)</th> <th>f (psi)</th> <th>Maximum Bending Moment (ftlb/ft)</th> <th>Upstand (ft)</th> <th>Toe (ft)</th> <th>Pile Length (ft)</th> </tr> </thead> <tbody> <tr> <td>Arbed AZ18</td> <td>250.40</td> <td>3.04E+07</td> <td>33.50</td> <td>25000.0</td> <td>69708.5</td> <td>3.00</td> <td>16.14</td> <td>24.14</td> </tr> </tbody> </table> </div> <div style="margin-top: 10px;"> Maxima <table border="1" style="width: 100%; border-collapse: collapse; font-size: 0.9em;"> <thead> <tr> <th></th> <th>Maximum</th> <th>Depth</th> </tr> </thead> <tbody> <tr> <td>Pressure</td> <td>735.2 psf</td> <td>5.53 ft</td> </tr> </tbody> </table> </div>	Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}	0.00	Loose Rock Fill	120.00	57.60	0.0	0.0	33.0	16.5	0.27	0.00	6.24	0.00	5.00	Peat	80.00	17.60	100.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00	9.00	Firm Clay	120.00	57.60	600.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00	13.50	Soft Clay	115.00	52.60	400.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00	18.00	Sandy Clay	120.00	57.60	200.0	0.0	28.0	14.0	0.33	1.14	4.33	4.16	Sheet Name	I (in ⁴ /ft)	E (psi)	Z (in ³ /ft)	f (psi)	Maximum Bending Moment (ftlb/ft)	Upstand (ft)	Toe (ft)	Pile Length (ft)	Arbed AZ18	250.40	3.04E+07	33.50	25000.0	69708.5	3.00	16.14	24.14		Maximum	Depth	Pressure	735.2 psf	5.53 ft
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47/90

Client: 216 Paterson Plank Road
Cooperating PRP Group

Title: Sheet Pile Wall Design Section
at RD-2

Designer: David Kun Li

Page: 3

Date: 9.13.06

Sheet: Arbed AZ18

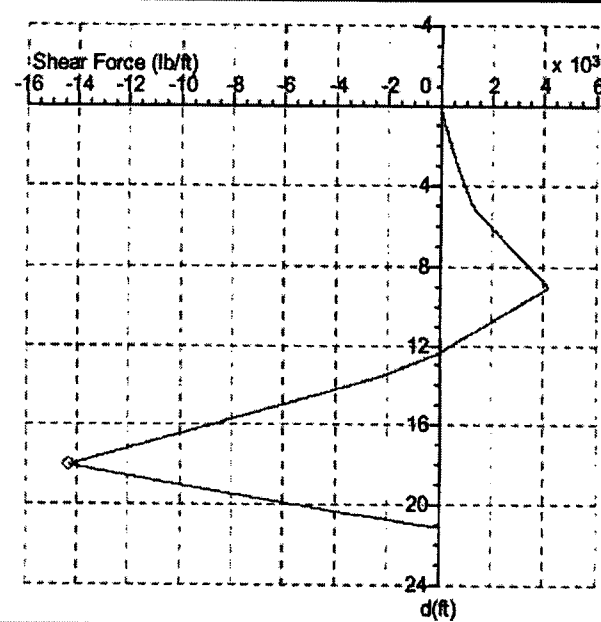
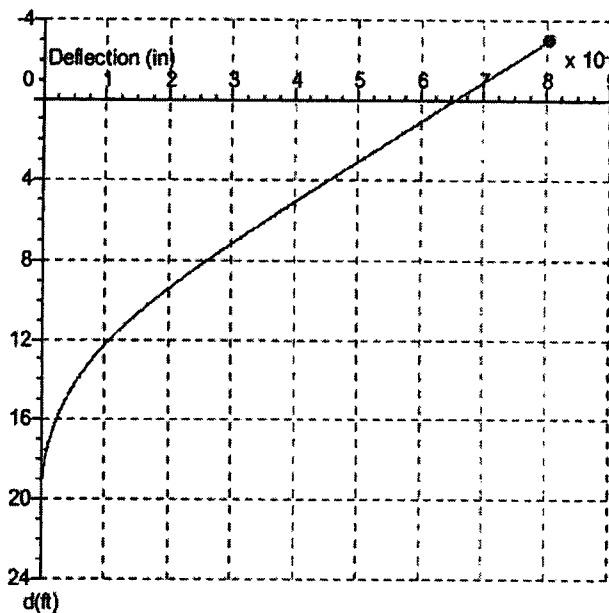
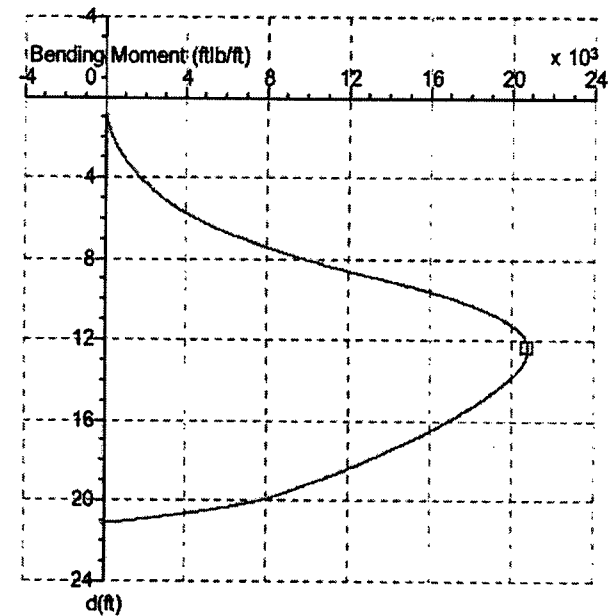
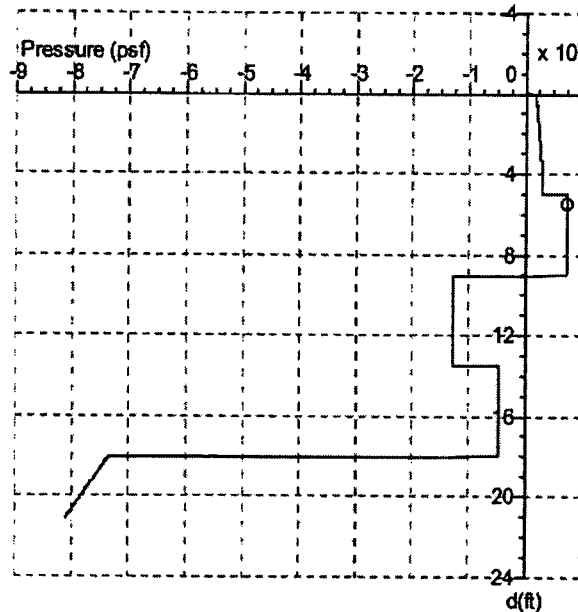
Pressure: Coulomb

FOS: 1.0

Toe: Cantilever

	Maximum	d (ft)
○	735.2 psf	5.53
□	20831.2 ftlb/ft	12.33
◇	14276.5 lb/ft	18.02
●	0.8 in	-3.00

216 Paterson Plank Road Site,
Carlstadt, Bergen County, New Jersey
Project No.: 943-6222



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47/1/90

Client: 216 Paterson Plank Road Cooperating PRP Group														
Title: Sheet Pile Wall Design Section at RD-2					depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)
Designer: David Kun Li					0.00	178.8	0.0	0.7	3.6	7.11	735.2	7186.5	0.3	2821.5
Page: 4					0.19	184.6	3.3	0.6	36.6	7.30	735.2	7708.0	0.3	2954.7
Date: 9.13.06					0.37	190.5	12.6	0.6	70.6	7.48	735.2	8315.8	0.3	3102.6
Sheet: Arbed AZ18					0.56	197.0	30.3	0.6	109.6	7.67	735.2	8888.3	0.3	3235.7
Pressure: Coulomb					0.75	202.9	53.1	0.6	145.9	7.86	735.2	9484.9	0.3	3368.8
FOS: 1.0					0.94	208.8	82.5	0.6	183.2	8.05	735.2	10176.0	0.3	3516.7
Toe: Cantilever					1.12	214.6	118.7	0.6	221.6	8.23	735.2	10823.5	0.3	3649.8
216 Paterson Plank Road Site, Carlstadt, Bergen County, New Jersey					1.31	221.1	167.3	0.6	265.5	8.42	735.2	11495.0	0.2	3782.9
Project No.: 943-6222					1.50	227.0	218.6	0.6	306.1	8.61	735.2	12190.7	0.2	3916.1
					1.68	232.9	277.4	0.6	347.8	8.79	735.2	12991.9	0.2	4064.0
					1.87	239.4	351.7	0.6	395.4	8.98	735.2	13738.5	0.2	4197.1
					2.06	245.3	426.8	0.6	439.3	9.17	-1264.8	14484.2	0.2	3994.2
					2.25	251.1	509.9	0.5	484.3	9.35	-1264.8	15264.7	0.2	3739.7
					2.43	257.7	612.0	0.5	535.6	9.54	-1264.8	15923.4	0.2	3510.7
					2.62	263.5	712.8	0.5	582.8	9.73	-1264.8	16540.6	0.2	3281.7
					2.81	269.4	822.2	0.5	631.1	9.92	-1264.8	17177.8	0.2	3027.3
					2.99	275.4	940.4	0.5	680.5	10.10	-1264.8	17707.5	0.2	2798.3
					3.18	278.5	1082.3	0.5	736.2	10.29	-1264.8	18195.8	0.2	2569.2
					3.37	281.3	1219.7	0.5	786.9	10.48	-1264.8	18642.5	0.2	2340.2
					3.56	284.1	1366.3	0.5	838.2	10.66	-1264.8	19090.3	0.2	2085.8
					3.74	287.2	1540.1	0.5	895.7	10.85	-1264.8	19449.6	0.1	1856.8
					3.93	290.0	1706.5	0.5	947.9	11.04	-1264.8	19767.3	0.1	1627.8
					4.12	292.9	1882.4	0.4	1000.7	11.23	-1264.8	20071.8	0.1	1373.3
					4.30	296.0	2089.1	0.4	1060.0	11.41	-1264.8	20302.0	0.1	1144.3
					4.49	298.8	2285.3	0.4	1113.9	11.60	-1264.8	20490.8	0.1	915.3
					4.68	301.6	2491.4	0.4	1168.3	11.79	-1264.8	20651.9	0.1	660.9
					4.86	304.4	2707.3	0.4	1223.2	11.97	-1264.8	20753.1	0.1	431.8
					5.05	735.2	2959.6	0.4	1312.9	12.16	-1264.8	20812.9	0.1	202.8
					5.24	735.2	3208.1	0.4	1446.0	12.35	-1264.8	20831.2	0.1	-0.7
					5.43	735.2	3480.6	0.4	1579.1	12.54	-1264.8	20816.7	0.1	-380.2
					5.61	735.2	3811.7	0.4	1727.0	12.72	-1264.8	20777.2	0.1	-721.7
					5.80	735.2	4135.1	0.4	1860.1	12.91	-1264.8	20712.6	0.1	-1063.2
					5.99	735.2	4482.6	0.4	1993.2	13.10	-1264.8	20608.1	0.1	-1442.6
					6.17	735.2	4897.0	0.3	2141.2	13.28	-1264.8	20489.7	0.1	-1784.1
					6.36	735.2	5295.4	0.3	2274.3	13.47	-1264.8	20346.3	0.1	-2125.6
					6.55	735.2	5717.9	0.3	2407.4	13.66	-464.8	20151.6	0.1	-2625.2
					6.74	735.2	6164.5	0.3	2540.5	13.85	-464.8	19954.4	0.1	-3111.5
					6.92	735.2	6689.0	0.3	2688.4	14.03	-464.8	19740.0	0.1	-3597.9
					14.22	-464.8	19548.9	0.1	-4084.2	14.41	-464.8	19283.5	0.0	-4624.6
					14.59	-464.8	19041.4	0.0	-5111.0	14.78	-464.8	18790.1	0.0	-5597.3
					14.97	-464.8	18491.6	0.0	-6137.7	15.16	-464.8	18220.5	0.0	-6624.1
					15.34	-464.8	17940.3	0.0	-7110.5	15.53	-464.8	17608.6	0.0	-7650.9
					15.72	-464.8	17308.6	0.0	-8137.2	15.90	-464.8	17044.1	0.0	-8623.6
					16.09	-464.8	16727.0	0.0	-9109.9	16.28	-464.8	16353.3	0.0	-9650.3
					16.46	-464.8	16016.4	0.0	-10136.7	16.65	-464.8	15670.3	0.0	-10623.1
					16.84	-464.8	15263.4	0.0	-11163.5	17.03	-464.8	14897.6	0.0	-11649.8
					17.21	-464.8	14522.5	0.0	-12136.2	17.40	-464.8	14082.5	0.0	-12676.6
					17.59	-464.8	13687.7	0.0	-13163.0	17.77	-464.8	13342.0	0.0	-13649.3
					17.96	-464.8	12930.0	0.0	-14135.7	18.15	-7377.9	12447.9	0.0	-13684.0
					18.34	-7423.1	12016.3	0.0	-12915.0	18.52	-7468.2	11575.3	0.0	-12137.8
					18.71	-7518.4	11060.1	0.0	-11264.7	18.90	-7563.6	10599.5	0.0	-10470.3
					19.08	-7608.7	10129.6	0.0	-9667.7	19.27	-7658.9	9581.3	0.0	-8766.3
					19.46	-7704.1	9162.2	0.0	-7946.4	19.65	-7749.2	8664.6	0.0	-7118.4
					19.83	-7794.4	8113.5	0.0	-6282.2	20.02	-7844.6	7307.3	0.0	-5343.4
					20.21	-7889.7	6444.6	0.0	-4489.9	20.39	-7934.9	5434.2	0.0	-3628.3
					20.58	-7985.1	4097.8	0.0	-2661.3	20.77	-8030.2	2768.8	0.0	-1782.4
					20.96	-8075.4	1289.9	0.0	-895.3	21.14	-8115.5	-97.4	0.0	0.0

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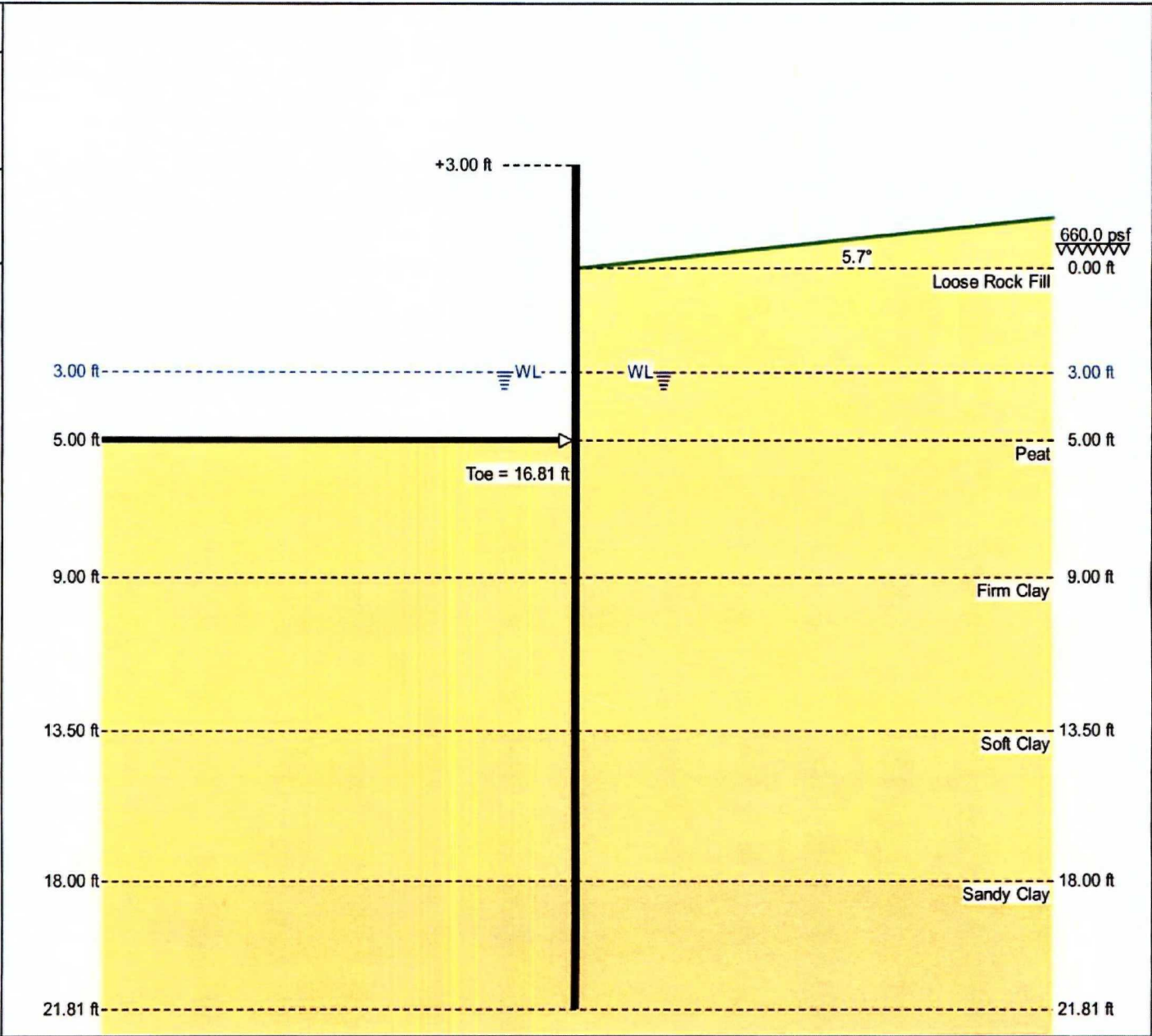
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at RD-2-10% Slope

Designer: David Kun Li
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50/90

Client: 216 Paterson Plank Road Cooperating PRP Group Title: Sheet Pile Wall Design Section at RD-2-10% Slope Designer: David Kun Li Page: 2 Date: 9.13.06 Sheet: Arbed AZ18 Pressure: Coulomb FOS: 1.0 Toe: Cantilever 216 Paterson Plank Road Site, Carlstadt, Bergen County, New Jersey Project No.: 943-6222	<div style="text-align: center;"><u>Input Data</u></div> <p> Depth Of Excavation = 5.00 ft Depth Of Active Water = 3.00 ft Water Density = 62.37 pcf Surcharge = 660.0 psf Depth Of Passive Water = 3.00 ft Minimum Fluid Density = 31.82 pcf Slope (active) = 5.7 degrees </p> <div style="text-align: center;"><u>Soil Profile</u></div> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Depth (ft)</th> <th>Soil Name</th> <th>γ (pcf)</th> <th>γ' (pcf)</th> <th>C (psf)</th> <th>C_u (psf)</th> <th>ϕ (°)</th> <th>δ (°)</th> <th>K_a</th> <th>K_{ac}</th> <th>K_p</th> <th>K_{pc}</th> </tr> </thead> <tbody> <tr> <td>0.00</td> <td>Loose Rock Fill</td> <td>120.00</td> <td>57.60</td> <td>0.0</td> <td>0.0</td> <td>33.0</td> <td>16.5</td> <td>0.27</td> <td>0.00</td> <td>6.24</td> <td>0.00</td> </tr> <tr> <td>5.00</td> <td>Peat</td> <td>80.00</td> <td>17.60</td> <td>100.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>1.00</td> <td>2.00</td> <td>1.00</td> <td>2.00</td> </tr> <tr> <td>9.00</td> <td>Firm Clay</td> <td>120.00</td> <td>57.60</td> <td>600.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>1.00</td> <td>2.00</td> <td>1.00</td> <td>2.00</td> </tr> <tr> <td>13.50</td> <td>Soft Clay</td> <td>115.00</td> <td>52.60</td> <td>400.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>1.00</td> <td>2.00</td> <td>1.00</td> <td>2.00</td> </tr> <tr> <td>18.00</td> <td>Sandy Clay</td> <td>120.00</td> <td>57.60</td> <td>200.0</td> <td>0.0</td> <td>28.0</td> <td>14.0</td> <td>0.33</td> <td>1.14</td> <td>4.33</td> <td>4.16</td> </tr> </tbody> </table> <div style="text-align: center;"><u>Solution</u></div> <div style="text-align: center;"><u>Sheet</u></div> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Sheet Name</th> <th>I (in⁴/ft)</th> <th>E (psi)</th> <th>Z (in²/ft)</th> <th>f (psi)</th> <th>Maximum Bending Moment (ftlb/ft)</th> <th>Upstand (ft)</th> <th>Toe (ft)</th> <th>Pile Length (ft)</th> </tr> </thead> <tbody> <tr> <td>Arbed AZ18</td> <td>250.40</td> <td>3.04E+07</td> <td>33.50</td> <td>25000.0</td> <td>69708.5</td> <td>3.00</td> <td>16.81</td> <td>24.81</td> </tr> </tbody> </table> <div style="text-align: center;"><u>Maxima</u></div> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Maximum</th> <th>Depth</th> </tr> </thead> <tbody> <tr> <td>Pressure</td> <td>813.9 psf</td> <td>8.99 ft</td> </tr> </tbody> </table>	Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_u (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}	0.00	Loose Rock Fill	120.00	57.60	0.0	0.0	33.0	16.5	0.27	0.00	6.24	0.00	5.00	Peat	80.00	17.60	100.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00	9.00	Firm Clay	120.00	57.60	600.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00	13.50	Soft Clay	115.00	52.60	400.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00	18.00	Sandy Clay	120.00	57.60	200.0	0.0	28.0	14.0	0.33	1.14	4.33	4.16	Sheet Name	I (in ⁴ /ft)	E (psi)	Z (in ² /ft)	f (psi)	Maximum Bending Moment (ftlb/ft)	Upstand (ft)	Toe (ft)	Pile Length (ft)	Arbed AZ18	250.40	3.04E+07	33.50	25000.0	69708.5	3.00	16.81	24.81		Maximum	Depth	Pressure	813.9 psf	8.99 ft
Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_u (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}																																																																																						
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5/1/90

Client: 216 Paterson Plank Road
Cooperating PRP Group

Title: Sheet Pile Wall Design Section
at RD-2-10% Slope

Designer: David Kun Li

Page: 3

Date: 9.13.06

Sheet: Arbed AZ18

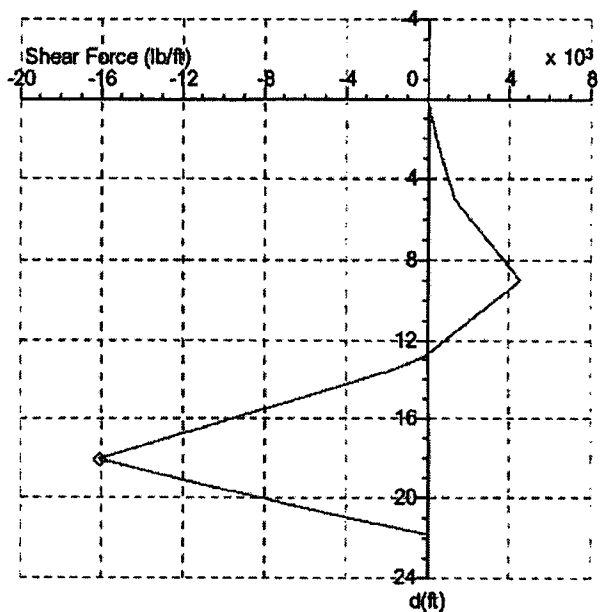
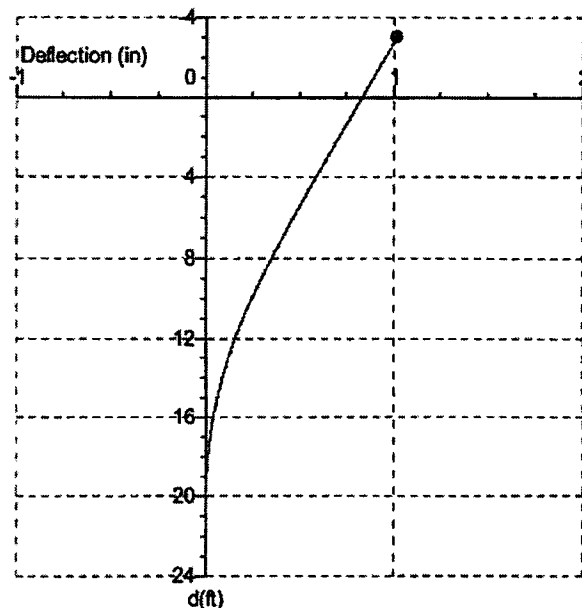
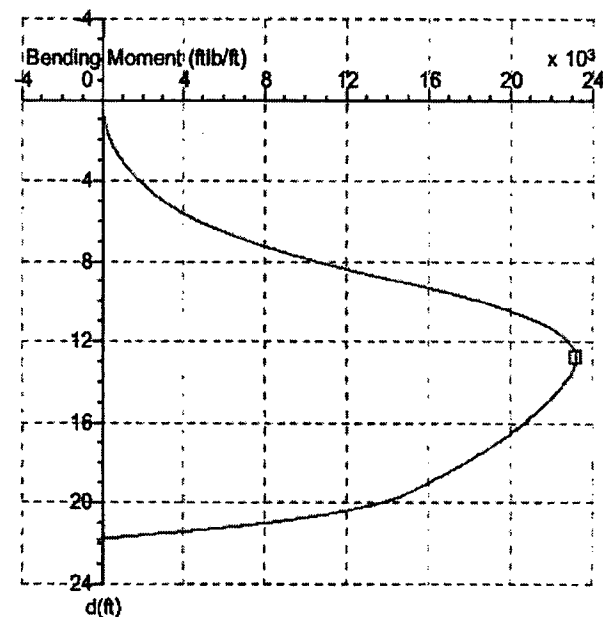
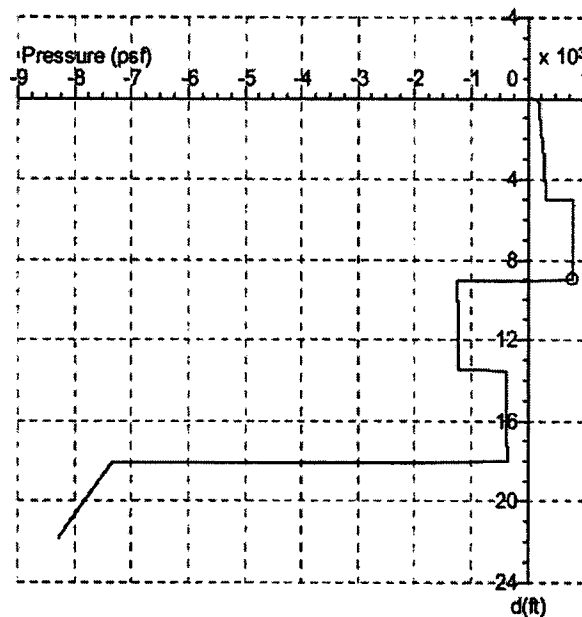
Pressure: Coulomb

FOS: 1.0

Toe: Cantilever

	Maximum	d (ft)
○	813.9 psf	8.99
□	23243.9 ft/lb/ft	12.71
◇	16120.4 lb/ft	18.03
●	1.0 in	-3.00

216 Paterson Plank Road Site,
Carlstadt, Bergen County, New Jersey
Project No.: 943-6222



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5/1/90

Client: 216 Paterson Plank Road Cooperating PRP Group					depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)
Title: Sheet Pile Wall Design Section at RD-2-10% Slope					0.00	189.0	0.0	0.8	3.9	7.33	806.3	8322.6	0.4	3208.1	14.67	-381.8	22102.9	0.1	-5495.9
Designer: David Kun Li					0.19	196.4	3.7	0.8	39.7	7.53	807.2	9001.4	0.4	3374.9	14.86	-380.6	21920.0	0.1	-6085.8
Page: 4					0.39	201.7	14.1	0.8	76.7	7.72	808.1	9641.8	0.4	3525.2	15.05	-379.3	21701.3	0.1	-6741.5
Date: 9.13.06					0.58	208.8	33.9	0.8	119.3	7.91	808.9	10310.1	0.4	3675.6	15.25	-378.0	21501.3	0.1	-7331.9
Sheet: Arbed AZ18					0.77	215.2	59.3	0.8	158.8	8.11	809.9	11085.6	0.3	3843.0	15.44	-376.8	21293.2	0.1	-7922.5
Pressure: Coulomb					0.97	221.6	92.2	0.8	199.5	8.30	810.7	11813.1	0.3	3993.7	15.63	-375.5	21045.7	0.1	-8578.9
FOS: 1.0					1.16	228.6	137.8	0.8	246.1	8.49	811.6	12568.7	0.3	4144.7	15.83	-374.3	20853.3	0.0	-9170.0
Toe: Cantilever					1.35	235.0	187.1	0.7	289.3	8.69	812.5	13441.3	0.3	4312.6	16.02	-373.0	20621.4	0.0	-9761.3
216 Paterson Plank Road Site, Carlstadt, Bergen County, New Jersey					1.54	241.4	244.6	0.7	333.7	8.88	813.4	14256.2	0.3	4463.8	16.21	-371.7	20346.7	0.0	-10418.6
Project No.: 943-6222					1.74	248.5	318.3	0.7	384.4	9.07	-1242.6	15095.7	0.3	4472.1	16.41	-370.5	20097.8	0.0	-11010.4
					1.93	254.8	393.7	0.7	431.3	9.26	-1241.2	15996.4	0.3	4215.4	16.60	-369.2	19841.1	0.0	-11602.4
					2.12	261.2	477.9	0.7	479.3	9.46	-1239.9	16761.7	0.3	3984.6	16.79	-367.9	19538.1	0.0	-12260.5
					2.32	268.3	582.0	0.7	534.1	9.65	-1238.7	17484.0	0.3	3754.0	16.98	-366.7	19264.5	0.0	-12852.9
					2.51	274.7	685.6	0.7	584.7	9.84	-1237.3	18236.3	0.3	3498.1	17.18	-365.4	19023.9	0.0	-13445.7
					2.70	281.0	798.6	0.7	636.5	10.04	-1236.0	18868.2	0.2	3268.0	17.37	-364.1	18694.1	0.0	-14104.5
					2.90	288.1	935.7	0.7	695.4	10.23	-1234.7	19457.2	0.2	3038.2	17.56	-362.9	18397.1	0.0	-14697.7
					3.09	292.7	1069.5	0.6	749.6	10.42	-1233.3	20061.6	0.2	2783.1	17.76	-361.6	18092.5	0.0	-15291.1
					3.28	295.8	1213.5	0.6	804.3	10.62	-1232.0	20560.4	0.2	2553.7	17.95	-360.3	17734.8	0.0	-15950.8
					3.47	299.2	1385.5	0.6	865.9	10.81	-1230.7	21016.6	0.2	2324.6	18.14	-359.0	17413.6	0.0	-16548.4
					3.67	302.2	1551.3	0.6	921.9	11.00	-1229.3	21473.6	0.2	2070.3	18.34	-357.7	17132.1	0.0	-17143.4
					3.86	305.3	1727.5	0.6	978.4	11.19	-1228.1	21839.9	0.2	1841.7	18.53	-356.4	16748.0	0.0	-17738.4
					4.05	308.7	1935.6	0.6	1041.9	11.39	-1226.8	22163.6	0.2	1613.3	18.72	-355.1	16403.8	0.0	-18333.4
					4.25	311.8	2134.3	0.6	1099.7	11.58	-1225.4	22473.6	0.2	1359.9	18.91	-353.8	16051.9	0.0	-18928.4
					4.44	314.8	2343.7	0.6	1158.0	11.77	-1224.1	22707.8	0.2	1132.0	19.11	-352.5	15640.4	0.0	-19523.4
					4.63	318.2	2589.2	0.5	1223.5	11.97	-1222.8	22899.6	0.2	904.4	19.30	-351.2	15227.3	0.0	-20118.4
					4.83	321.3	2821.8	0.5	1283.0	12.16	-1221.4	23063.0	0.2	651.7	19.49	-350.0	14814.2	0.0	-20713.4
					5.02	324.4	3065.5	0.5	1353.3	12.35	-1220.1	23165.5	0.1	424.6	19.69	-348.7	14401.1	0.0	-21308.4
					5.21	327.5	3360.6	0.5	1517.9	12.55	-1218.9	23225.7	0.1	197.7	19.88	-347.4	13988.0	0.0	-21903.4
					5.40	330.6	3655.3	0.5	1666.2	12.74	-1217.5	23243.8	0.1	-52.0	20.07	-346.1	13574.9	0.0	-22498.4
					5.60	333.7	3977.6	0.5	1814.7	12.93	-1216.2	23228.7	0.1	-486.4	20.27	-344.8	13161.8	0.0	-23093.4
					5.79	336.8	4368.1	0.5	1979.9	13.12	-1214.9	23188.1	0.1	-921.1	20.46	-343.5	12748.7	0.0	-23688.4
					5.98	340.0	4748.8	0.5	2128.7	13.32	-1213.5	23110.5	0.1	-1404.3	20.65	-342.2	12335.6	0.0	-24283.4
					6.18	343.1	5157.2	0.5	2277.6	13.51	-821.9	23030.5	0.1	-1839.5	20.84	-340.9	11922.5	0.0	-24878.4
					6.37	346.2	5643.5	0.4	2443.3	13.70	-388.2	22913.6	0.1	-2419.0	21.04	-339.6	11509.4	0.0	-25473.4
					6.56	349.3	6110.5	0.4	2592.6	13.90	-386.9	22753.3	0.1	-3073.2	21.23	-338.3	11096.3	0.0	-26068.4
					6.76	352.4	6605.3	0.4	2742.1	14.09	-385.6	22602.8	0.1	-3662.1	21.42	-337.0	10683.2	0.0	-26663.4
					6.95	355.5	7187.6	0.4	2908.4	14.28	-384.4	22444.3	0.1	-4251.3	21.62	-335.7	10270.1	0.0	-27258.4
					7.14	358.6	7741.2	0.4	3058.2	14.48	-383.1	22253.1	0.1	-4906.2	21.81	-334.4	9857.0	0.0	-27853.4

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Sheet Pile Design According to Blum-Method

Project Name: Sheet Pile Wall Design at RD-3

Date: 9/12/2006

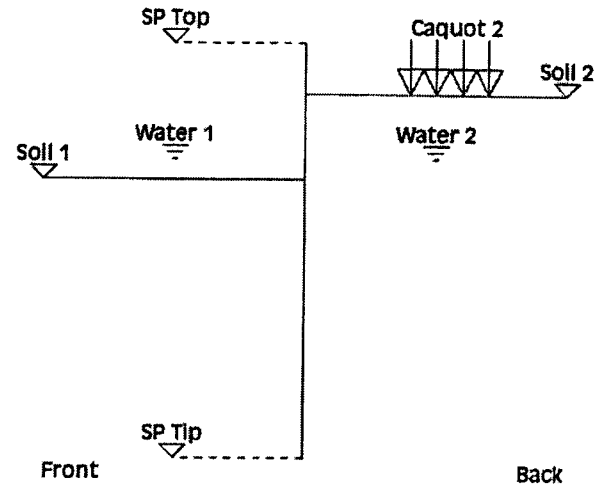
Author: DKL

Company:

Comment:

Geodata

	Unit
Sheet Pile Top Level (ft)	-3.000
Sheet Pile Tip Level (ft)	21.370
Soil Level in Front (ft)	5.000
Soil Level behind (ft)	0.000
Anchor level (ft)	-3.000
Water Level in Front (ft)	3.000
Water Level behind (ft)	3.000
Soil Surface Inclination in Front (Deg)	0.000
Soil Surface Inclination behind (Deg)	0.000
Caquot Surcharge in Front (kip/ft ²)	0.000
Caquot Surcharge behind (kip/ft ²)	0.660
Anchor Inclination (Deg)	0.000
Earth Support	Cantilever



Soil Layers

Layers In Front

	Layer Tip [ft]	Density Moist [kip/ft ³]	Density Submerged [kip/ft ³]	Kph	Phi [Deg]	Delta [Deg]	Cohesion [kip/ft ²]
Layer 1	6.070	0.120	0.058	5.954	33.000	-16.500	0.000
Layer 2	10.000	0.080	0.018	1.000	0.000	0.000	0.100
Layer 3	15.500	0.120	0.058	1.000	0.000	0.000	0.600
Layer 4	21.000	0.115	0.053	1.000	0.000	0.000	0.400
Layer 5	40.000	0.120	0.058	4.216	28.000	-14.000	0.200

Layers behind

	Layer Tip [ft]	Density Moist [kip/ft ³]	Density Submerged [kip/ft ³]	Kph	Phi [Deg]	Delta [Deg]	Cohesion [kip/ft ²]
Layer 1	6.070	0.120	0.058	0.256	33.000	16.500	0.000
Layer 2	10.000	0.080	0.018	1.000	0.000	0.000	0.100
Layer 3	15.500	0.120	0.058	1.000	0.000	0.000	0.600
Layer 4	21.000	0.115	0.053	1.000	0.000	0.000	0.400
Layer 5	40.000	0.120	0.058	0.317	28.000	14.000	0.200

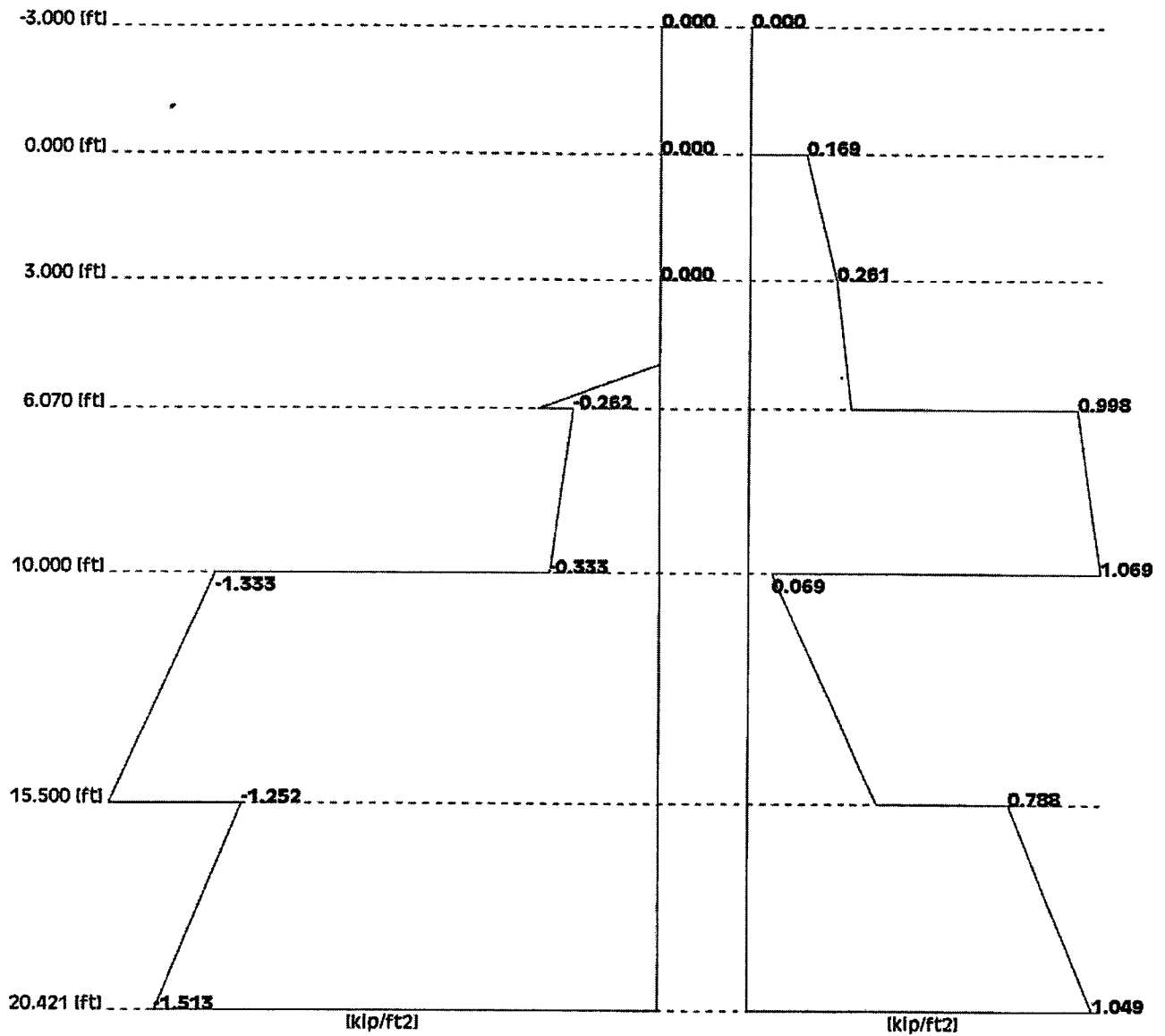
Pile Section

Name	AZ13-1
Inertia (in ⁴ /ft)	132.835
Modulus (in ³ /ft)	22.320
Area (in ² /ft)	5.939
Mass (lbs/ft ²)	20.215
Steel Grade (lb/in ²)	34795.867
Requested Safety	1.500

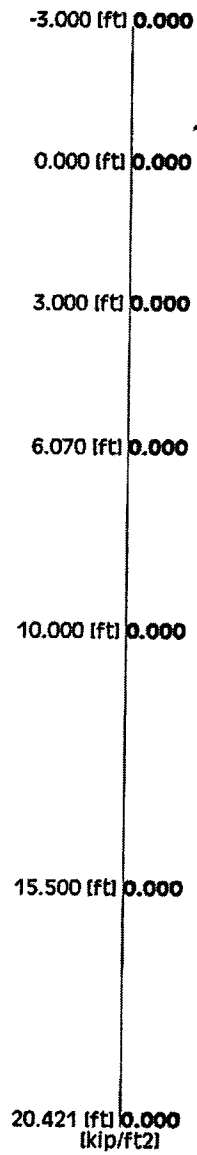
Pile Check

		Depth (ft)
Name	AZ13-1	
Inertia (in ⁴ /ft)	132.835	
Modulus (in ³ /ft)	22.320	
Area (in ² /ft)	5.939	
Mass (lbs/ft ²)	20.215	
Steel Grade (lb/in ²)	34795.867	
Minimal Moment (kip-ft/ft)	-0.236	20.454
Maximal Moment (kip-ft/ft)	21.999	13.281
Normal Forces at Max. Moment (kip/ft)	0.390	20.454
Normal Forces at Min. Moment (kip/ft)	0.391	13.281
Deflection at Min. Moment (ft)	0.000	20.454
Deflection at Max. Moment (ft)	-0.009	13.281
Min. Stress at Min. Moment (lb/in ²)	-61.295	20.454
Max. Stress at Min. Moment (lb/in ²)	192.738	20.454
Min. Stress at Max. Moment (lb/in ²)	-11762.878	13.281
Max. Stress at Max. Moment (lb/in ²)	11894.522	13.281
Safety > Req. Safety = 1.500	2.925	
Sheet Pile Top Level (ft)	-3.000	
Sheet Pile Tip Level (ft)	21.370	
Sheet Pile Length (ft)	24.370	
Included OverLength (ft)	0.948	
Vertical Equilibrium (kip/ft)	0.391	
Anchor Force (horiz.) (kip/ft)	0.000	

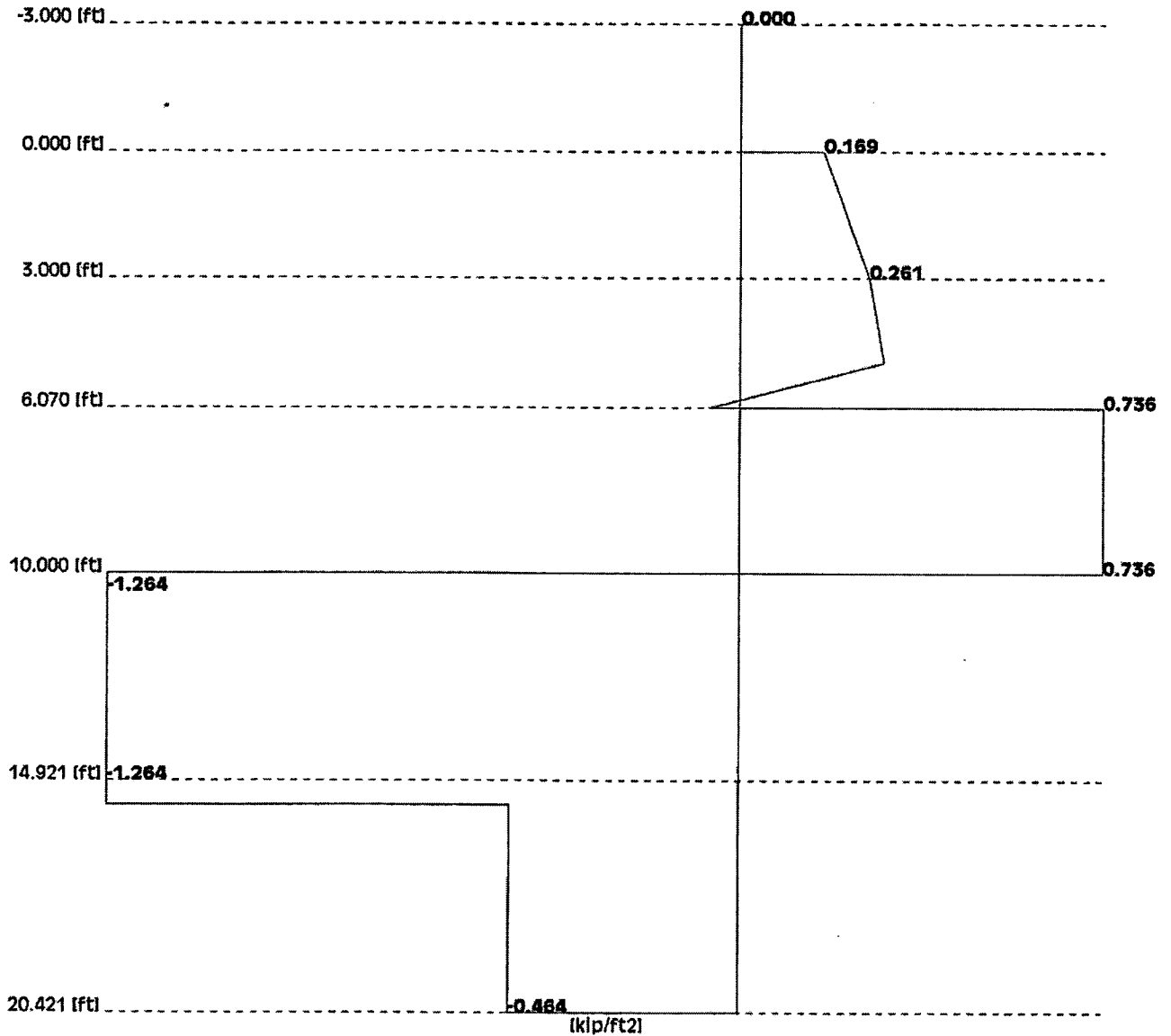
Earth Pressure Diagram



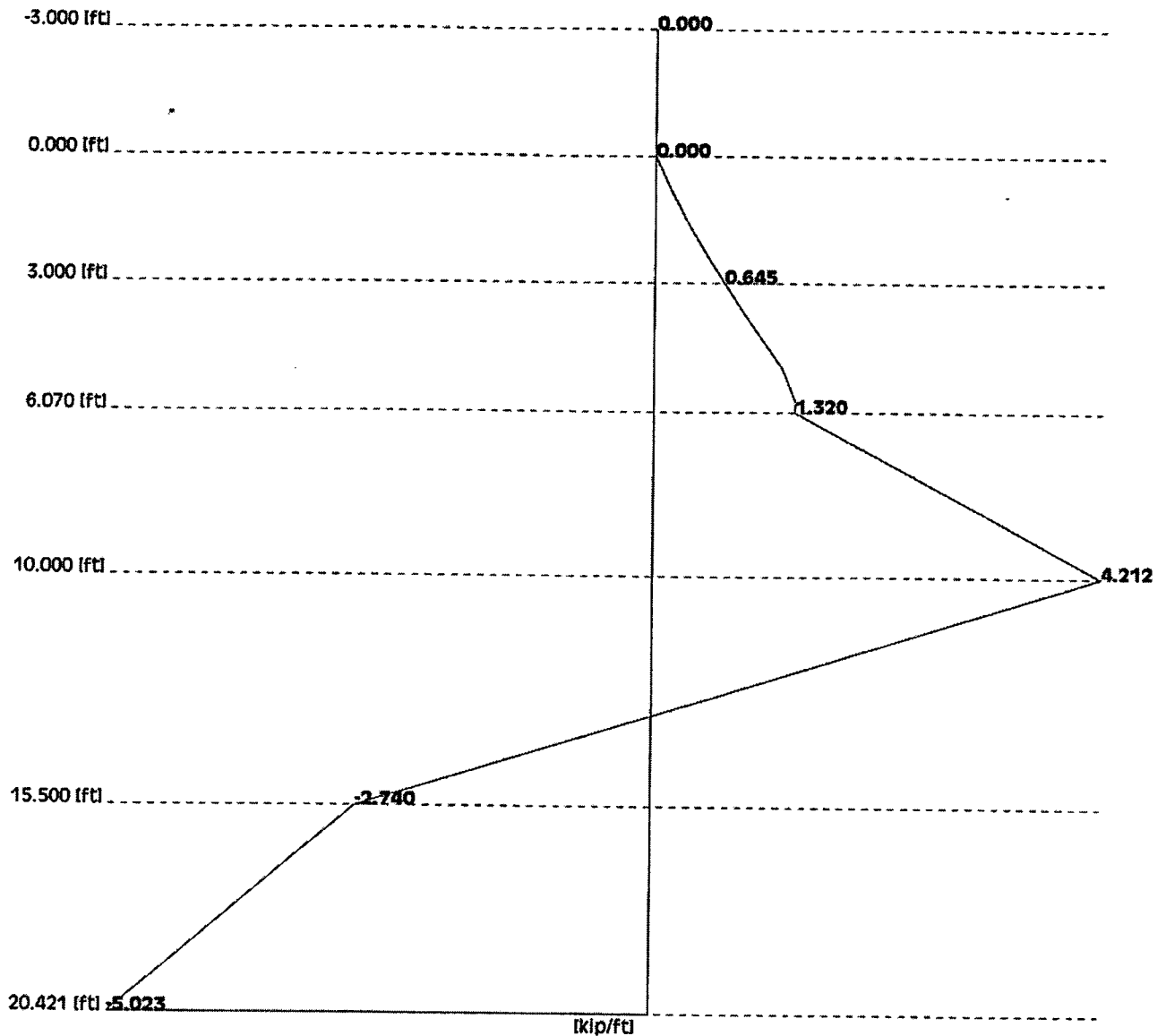
Water Pressure Diagram



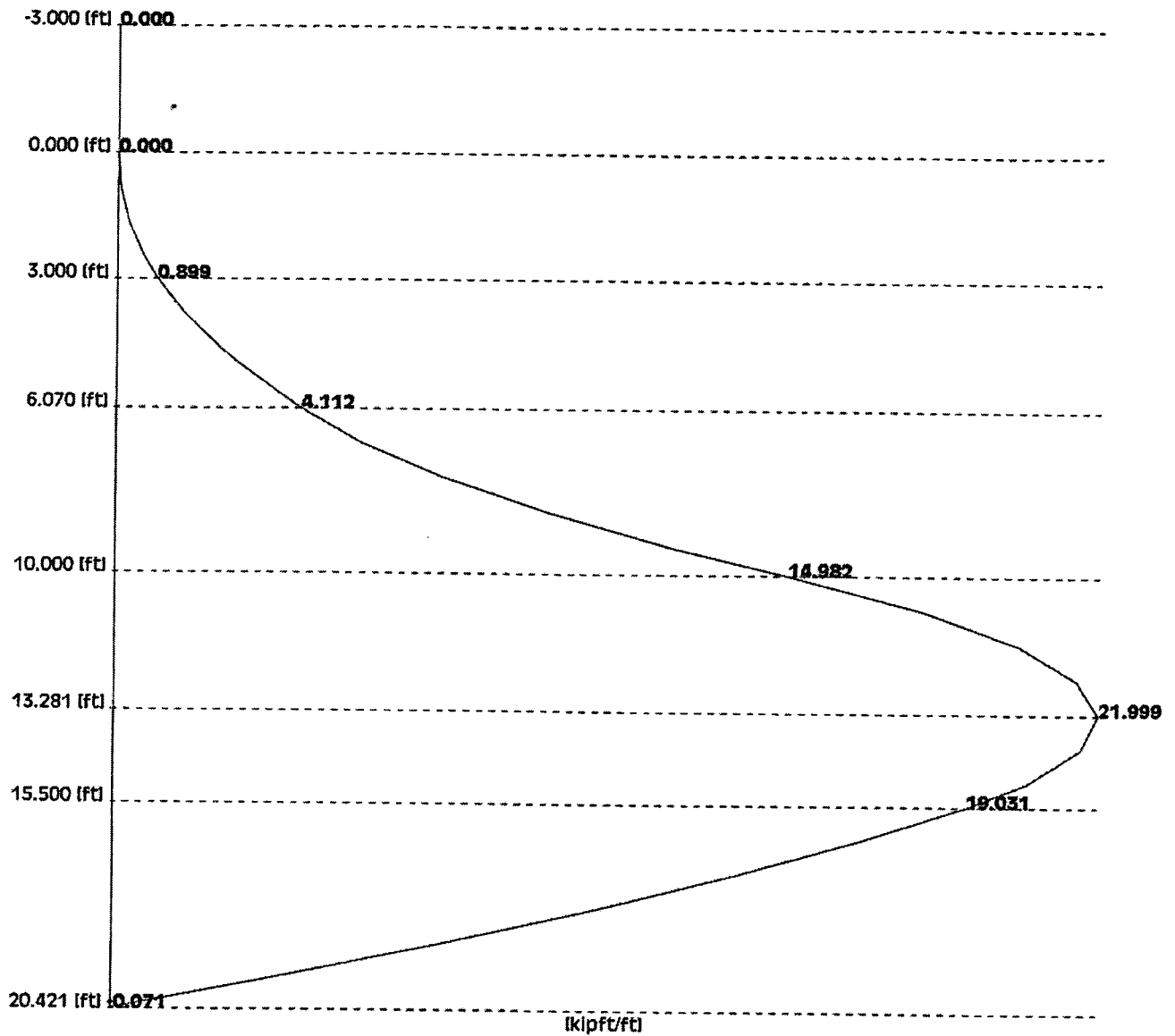
Total Pressure Diagram



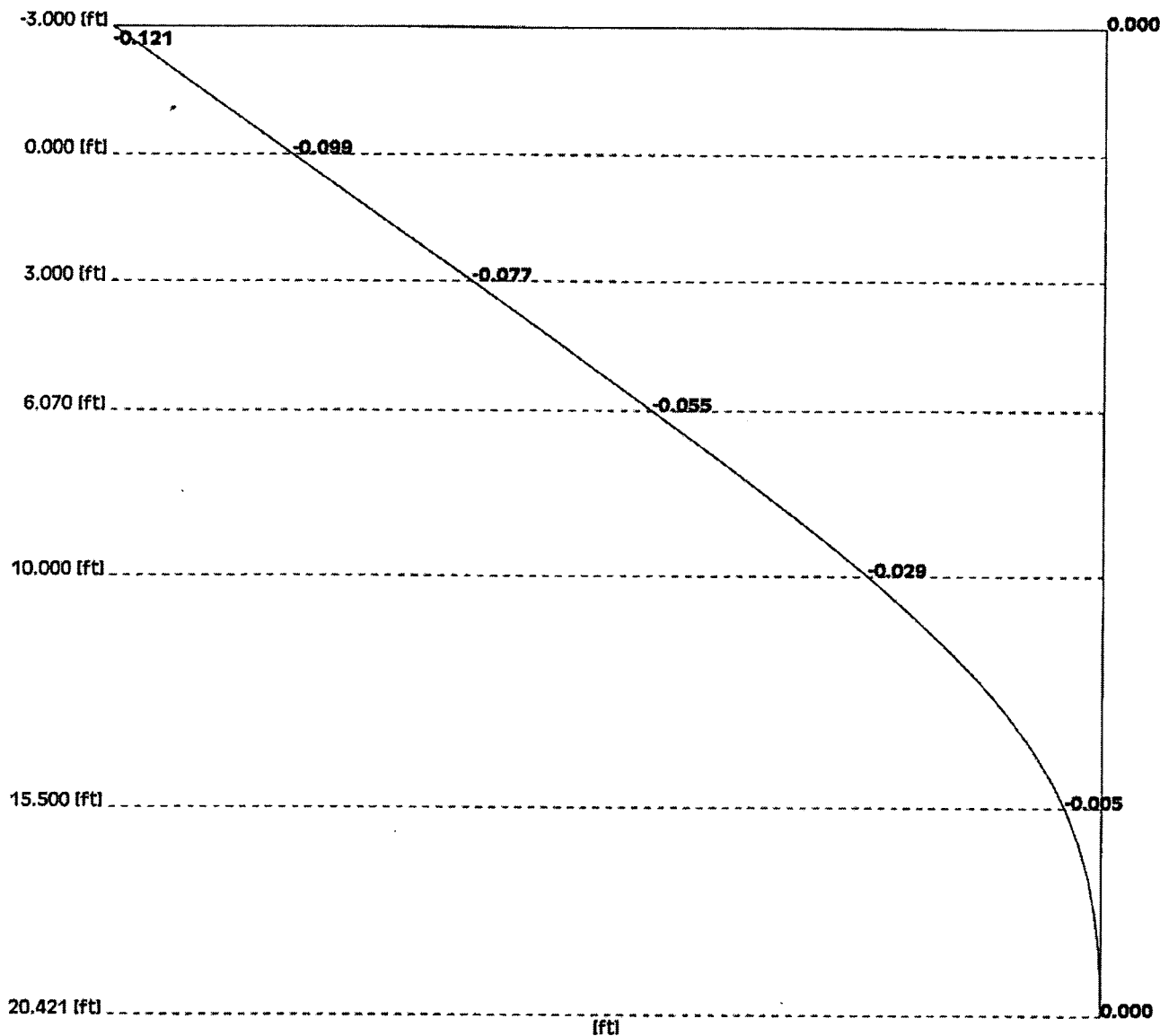
Cross Force Diagram



Moment Diagram



Deflection Diagram



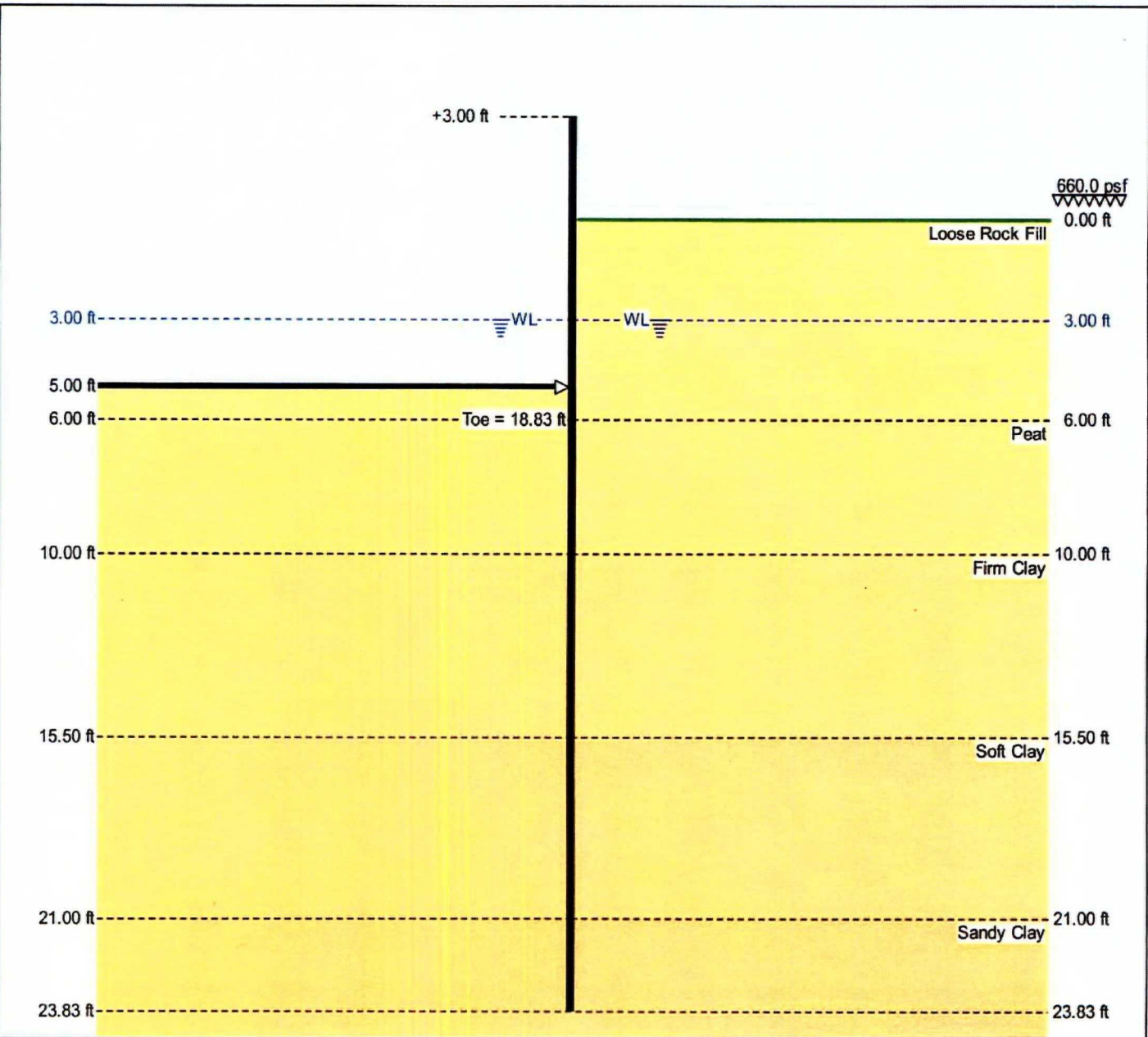
64/90

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Title: Sheet Pile Wall Design Section
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Designer: David Kun Li
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65/90

<p>Client: 216 Paterson Plank Road Cooperating PRP Group</p> <p>Title: Sheet Pile Wall Design Section at RD-3</p> <p>Designer: David Kun Li</p> <p>Page: 2</p> <p>Date: 9.13.06</p> <p>Sheet: Arbed AZ18</p> <p>Pressure: Coulomb</p> <p>FOS: 1.0</p> <p>Toe: Cantilever</p> <p>216 Paterson Plank Road Site, Carlstadt, Bergen County, New Jersey</p> <p>Project No.: 943-6222</p>	<div style="text-align: right; font-weight: bold;">Input Data</div> <p>Depth Of Excavation = 5.00 ft Depth Of Active Water = 3.00 ft Water Density = 62.37 pcf</p> <p>Surcharge = 660.0 psf Depth Of Passive Water = 3.00 ft Minimum Fluid Density = 31.82 pcf</p> <p>Soil Profile</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Depth (ft)</th> <th>Soil Name</th> <th>γ (pcf)</th> <th>γ' (pcf)</th> <th>C (psf)</th> <th>C_u (psf)</th> <th>ϕ (°)</th> <th>δ (°)</th> <th>K_a</th> <th>K_{ac}</th> <th>K_p</th> <th>K_{pc}</th> </tr> </thead> <tbody> <tr> <td>0.00</td> <td>Loose Rock Fill</td> <td>120.00</td> <td>57.60</td> <td>0.0</td> <td>0.0</td> <td>33.0</td> <td>16.5</td> <td>0.27</td> <td>0.00</td> <td>6.24</td> <td>0.00</td> </tr> <tr> <td>6.00</td> <td>Peat</td> <td>80.00</td> <td>17.60</td> <td>100.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>1.00</td> <td>2.00</td> <td>1.00</td> <td>2.00</td> </tr> <tr> <td>10.00</td> <td>Firm Clay</td> <td>120.00</td> <td>57.60</td> <td>600.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>1.00</td> <td>2.00</td> <td>1.00</td> <td>2.00</td> </tr> <tr> <td>15.50</td> <td>Soft Clay</td> <td>115.00</td> <td>52.60</td> <td>400.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>1.00</td> <td>2.00</td> <td>1.00</td> <td>2.00</td> </tr> <tr> <td>21.00</td> <td>Sandy Clay</td> <td>120.00</td> <td>57.60</td> <td>200.0</td> <td>0.0</td> <td>28.0</td> <td>14.0</td> <td>0.33</td> <td>1.14</td> <td>4.33</td> <td>4.16</td> </tr> </tbody> </table> <div style="text-align: right; font-weight: bold;">Solution</div> <p>Sheet</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Sheet Name</th> <th>I (in⁴/ft)</th> <th>E (psi)</th> <th>Z (in³/ft)</th> <th>f (psf)</th> <th>Maximum Bending Moment (ftlb/ft)</th> <th>Upstand (ft)</th> <th>Toe (ft)</th> <th>Pile Length (ft)</th> </tr> </thead> <tbody> <tr> <td>Arbed AZ18</td> <td>250.40</td> <td>3.04E+07</td> <td>33.50</td> <td>25000.0</td> <td>69708.5</td> <td>3.00</td> <td>18.83</td> <td>26.83</td> </tr> </tbody> </table> <p>Maxima</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Maximum</th> <th>Depth</th> </tr> </thead> <tbody> <tr> <td>Pressure</td> <td>735.2 psf</td> <td>6.03 ft</td> </tr> </tbody> </table>	Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_u (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}	0.00	Loose Rock Fill	120.00	57.60	0.0	0.0	33.0	16.5	0.27	0.00	6.24	0.00	6.00	Peat	80.00	17.60	100.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00	10.00	Firm Clay	120.00	57.60	600.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00	15.50	Soft Clay	115.00	52.60	400.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00	21.00	Sandy Clay	120.00	57.60	200.0	0.0	28.0	14.0	0.33	1.14	4.33	4.16	Sheet Name	I (in ⁴ /ft)	E (psi)	Z (in ³ /ft)	f (psf)	Maximum Bending Moment (ftlb/ft)	Upstand (ft)	Toe (ft)	Pile Length (ft)	Arbed AZ18	250.40	3.04E+07	33.50	25000.0	69708.5	3.00	18.83	26.83		Maximum	Depth	Pressure	735.2 psf	6.03 ft
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Client: 216 Paterson Plank Road
Cooperating PRP Group

Title: Sheet Pile Wall Design Section
at RD-3

Designer: David Kun Li

Page: 3

Date: 9.13.06

Sheet: Arbed AZ18

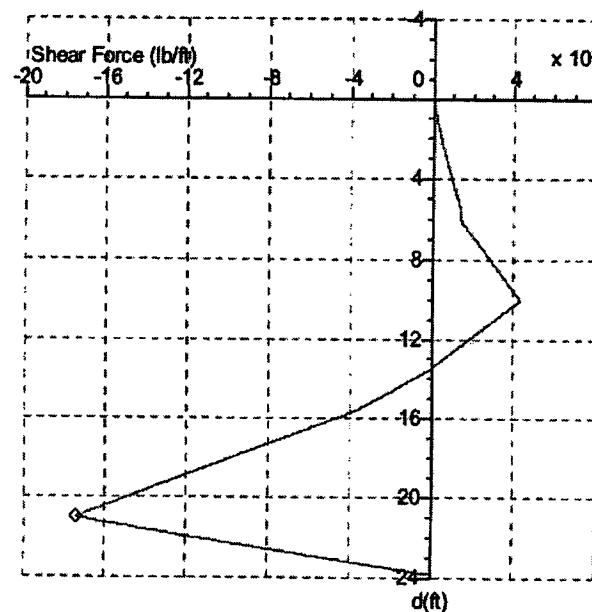
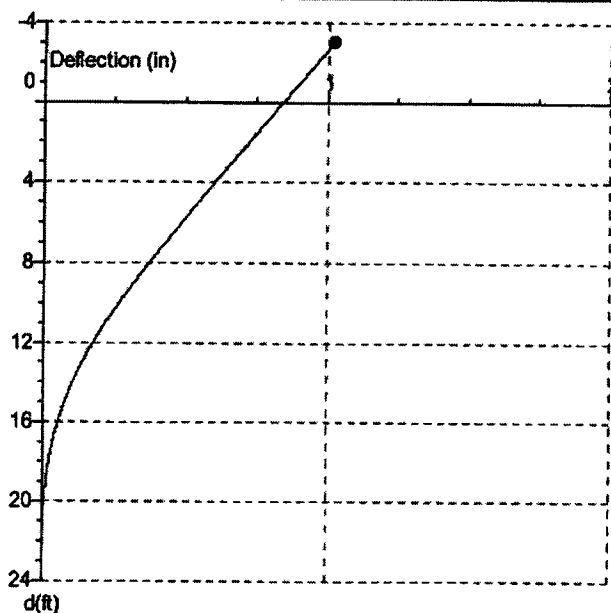
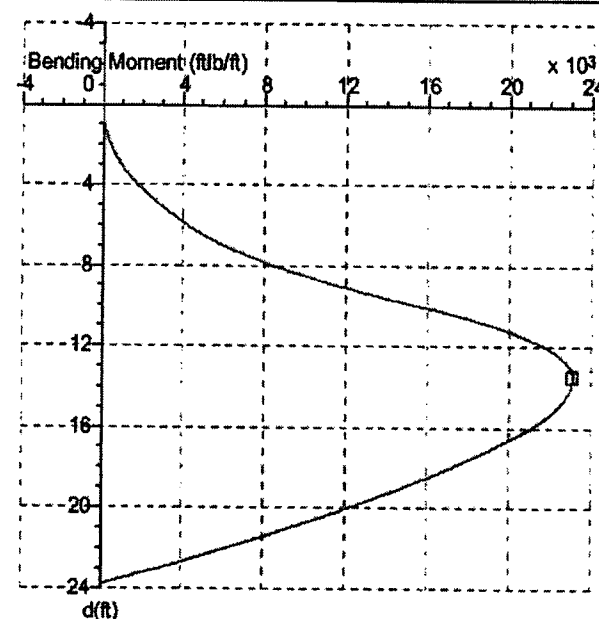
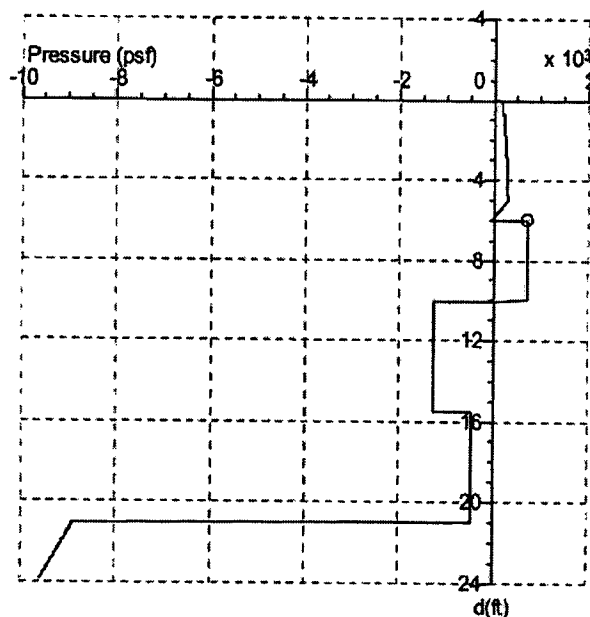
Pressure: Coulomb

FOS: 1.0

Toe: Cantilever

	Maximum	d (ft)
○	735.2 psf	6.03
□	23150.1 ftlb/ft	13.45
◇	17430.1 lb/ft	21.01
●	1.0 in	-3.00

216 Paterson Plank Road Site,
Carlstadt, Bergen County, New Jersey
Project No.: 943-6222



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Title: Sheet Pile Wall Design Section at RD-3 Designer: David Kun Li Page: 4 Date: 9.13.06					depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)
Sheet: Arbed AZ18 Pressure: Coulomb FOS: 1.0 Toe: Cantilever					0.00	178.8	0.0	0.8	4.0	8.01	735.2	8532.8	0.4	2879.2
216 Paterson Plank Road Site, Carlstadt, Bergen County, New Jersey Project No.: 943-6222					0.21	185.3	4.1	0.8	40.7	8.22	735.2	9193.0	0.4	3043.6
					0.42	192.6	17.4	0.8	83.0	8.43	735.2	9818.6	0.4	3191.5
					0.63	199.1	37.6	0.8	122.5	8.65	735.2	10474.0	0.3	3339.5
					0.84	205.6	65.9	0.8	163.3	8.86	735.2	11237.1	0.3	3503.8
					1.05	212.8	107.1	0.8	210.1	9.07	735.2	11955.3	0.3	3651.8
					1.27	219.4	153.2	0.8	253.7	9.28	735.2	12788.3	0.3	3816.1
					1.48	226.6	214.9	0.8	303.6	9.49	735.2	13569.3	0.3	3964.0
					1.69	233.1	280.1	0.7	349.9	9.70	735.2	14472.1	0.3	4128.4
					1.90	240.4	363.7	0.7	402.9	9.91	735.2	15315.9	0.3	4276.3
					2.11	246.9	449.1	0.7	452.0	10.12	-1264.8	16177.9	0.3	4185.4
					2.32	253.4	544.5	0.7	502.4	10.33	-1264.8	17085.2	0.3	3902.7
					2.53	260.6	662.6	0.7	560.0	10.54	-1264.8	17847.7	0.2	3648.2
					2.74	267.2	780.0	0.7	613.1	10.75	-1264.8	18634.9	0.2	3365.4
					2.95	274.4	923.2	0.7	673.8	10.97	-1264.8	19289.3	0.2	3110.9
					3.16	278.1	1063.7	0.7	729.4	11.18	-1264.8	19956.4	0.2	2828.2
					3.37	281.5	1233.1	0.6	792.0	11.39	-1264.8	20502.7	0.2	2573.7
					3.58	284.7	1397.5	0.6	849.0	11.60	-1264.8	20997.8	0.2	2319.2
					3.80	287.8	1573.5	0.6	906.6	11.81	-1264.8	21487.9	0.2	2036.5
					4.01	291.3	1782.7	0.6	971.4	12.02	-1264.8	21874.9	0.2	1782.0
					4.22	294.4	1983.4	0.6	1030.3	12.23	-1264.8	22244.8	0.2	1499.2
					4.43	297.9	2220.4	0.6	1096.6	12.44	-1264.8	22523.7	0.2	1244.7
					4.64	301.0	2446.4	0.6	1156.9	12.65	-1264.8	22773.5	0.2	962.0
					4.85	304.5	2711.8	0.6	1224.6	12.86	-1264.8	22944.3	0.1	707.5
					5.06	282.2	2963.7	0.5	1285.0	13.07	-1264.8	23063.9	0.1	453.0
					5.27	213.0	3226.9	0.5	1334.1	13.28	-1264.8	23136.8	0.1	170.3
					5.48	136.1	3529.3	0.5	1372.2	13.50	-1264.8	23148.3	0.1	-66.3
					5.69	66.9	3807.4	0.5	1391.9	13.71	-1264.8	23127.5	0.1	-452.5
					5.90	-10.0	4119.4	0.5	1397.4	13.92	-1264.8	23074.5	0.1	-800.1
					6.12	735.2	4404.4	0.5	1482.2	14.13	-1264.8	22990.5	0.1	-1186.3
					6.33	735.2	4752.3	0.5	1646.5	14.34	-1264.8	22893.9	0.1	-1533.8
					6.54	735.2	5096.9	0.5	1794.4	14.55	-1264.8	22752.4	0.1	-1881.4
					6.75	735.2	5514.6	0.4	1958.8	14.76	-1264.8	22579.9	0.1	-2267.6
					6.96	735.2	5921.9	0.4	2106.7	14.97	-1264.8	22407.4	0.1	-2615.2
					7.17	735.2	6359.0	0.4	2254.7	15.18	-1264.8	22177.3	0.1	-3001.4
					7.38	735.2	6879.6	0.4	2419.0	15.39	-1264.8	21916.3	0.1	-3349.0
					7.59	735.2	7379.6	0.4	2567.0	15.60	-464.8	21624.4	0.1	-3812.6
					7.80	735.2	7970.0	0.4	2731.3	15.81	-464.8	21349.5	0.1	-4321.2
					16.03	-464.8	20947.5	0.1	-4886.2	16.24	-464.8	20619.5	0.1	-5394.7
					16.45	-464.8	20270.4	0.0	-5903.2	16.66	-464.8	19789.1	0.0	-6468.3
					16.87	-464.8	19418.4	0.0	-6976.8	17.08	-464.8	18975.4	0.0	-7541.8
					17.29	-464.8	18586.6	0.0	-8050.4	17.50	-464.8	18055.2	0.0	-8615.4
					17.71	-464.8	17646.8	0.0	-9124.0	17.92	-464.8	17230.2	0.0	-9632.5
					18.13	-464.8	16661.6	0.0	-10197.5	18.35	-464.8	16225.4	0.0	-10706.1
					18.56	-464.8	15705.9	0.0	-11271.1	18.77	-464.8	15175.0	0.0	-11779.7
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					19.40	-464.8	13595.6	0.0	-13361.8	19.61	-464.8	13020.8	0.0	-13926.8
					19.82	-464.8	12519.1	0.0	-14435.4	20.03	-464.8	11923.2	0.0	-15000.4
					20.24	-464.8	11316.0	0.0	-15509.0	20.45	-464.8	10697.3	0.0	-16074.0
					20.66	-464.8	10158.0	0.0	-16582.6	20.88	-464.8	9518.1	0.0	-17091.1
					21.09	-8898.9	8867.0	0.0	-17029.8	21.30	-8949.1	8299.7	0.0	-15836.9
					21.51	-9004.8	7627.4	0.0	-14499.6	21.72	-9055.0	6943.7	0.0	-13285.4
					21.93	-9110.8	6248.6	0.0	-11924.4	22.14	-9160.9	5643.8	0.0	-10688.8
					22.35	-9211.1	4927.5	0.0	-9443.2	22.56	-9266.9	4199.9	0.0	-8047.3
					22.77	-9317.1	3567.2	0.0	-6780.3	22.98	-9372.8	2818.4	0.0	-5360.7
					23.20	-9423.0	2058.3	0.0	-4072.5	23.41	-9478.8	1286.7	0.0	-2629.2
					23.62	-9529.0	616.4	0.0	-1319.6	23.83	-9573.6	-62.4	0.0	0.0

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Client: 216 Paterson Plank Road
Cooperating PRP Group

Title: Sheet Pile Wall Design Section
at RD-3-10% Slope

Designer: David Kun Li

Page: 1

Date: 9.13.06

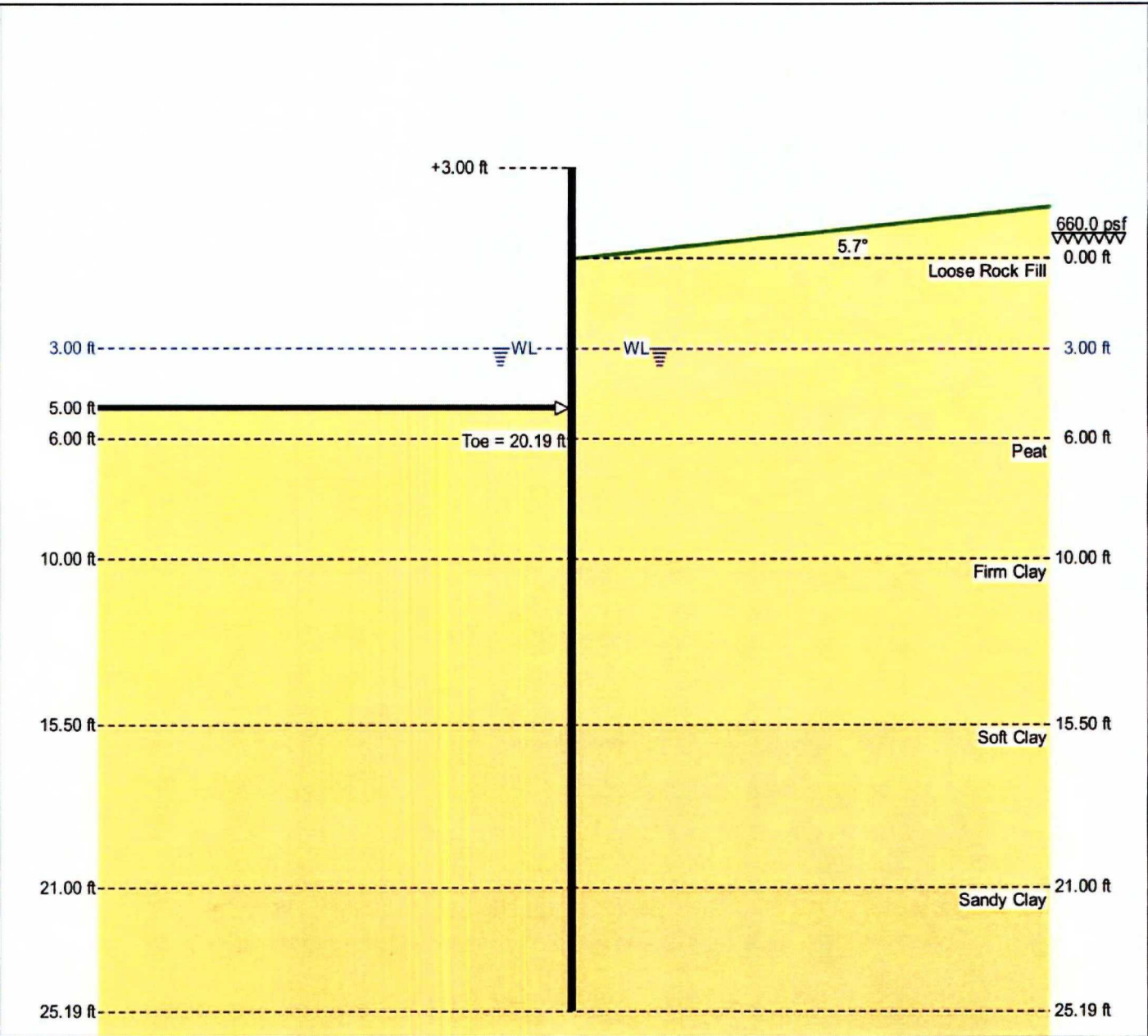
Sheet: Arbed AZ18

Pressure: Coulomb

FOS: 1.0

Toe: Cantilever

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Client: 216 Paterson Plank Road Cooperating PRP Group	Input Data																																																																																	
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15.50	Soft Clay	115.00	52.60	400.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00																																																																							
21.00	Sandy Clay	120.00	57.60	200.0	0.0	28.0	14.0	0.33	1.14	4.33	4.16																																																																							
216 Paterson Plank Road Site, Carlstadt, Bergen County, New Jersey Project No.: 943-6222	Solution <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Sheet Name</th> <th>I (in⁴/ft)</th> <th>E (psi)</th> <th>Z (in²/ft)</th> <th>f (psi)</th> <th>Maximum Bending Moment (ft-lb/ft)</th> <th>Upstand (ft)</th> <th>Toe (ft)</th> <th>Pile Length (ft)</th> </tr> </thead> <tbody> <tr> <td>Arbed AZ18</td> <td>250.40</td> <td>3.04E+07</td> <td>33.50</td> <td>25000.0</td> <td>69708.5</td> <td>3.00</td> <td>20.19</td> <td>28.19</td> </tr> </tbody> </table> Maxima <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th></th> <th>Maximum</th> <th>Depth</th> </tr> </thead> <tbody> <tr> <td>Pressure</td> <td>820.7 psf</td> <td>9.99 ft</td> </tr> </tbody> </table>										Sheet Name	I (in ⁴ /ft)	E (psi)	Z (in ² /ft)	f (psi)	Maximum Bending Moment (ft-lb/ft)	Upstand (ft)	Toe (ft)	Pile Length (ft)	Arbed AZ18	250.40	3.04E+07	33.50	25000.0	69708.5	3.00	20.19	28.19		Maximum	Depth	Pressure	820.7 psf	9.99 ft																																																
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7/0/90

Client: 216 Paterson Plank Road
Cooperating PRP Group

Title: Sheet Pile Wall Design Section
at RD-3-10% Slope

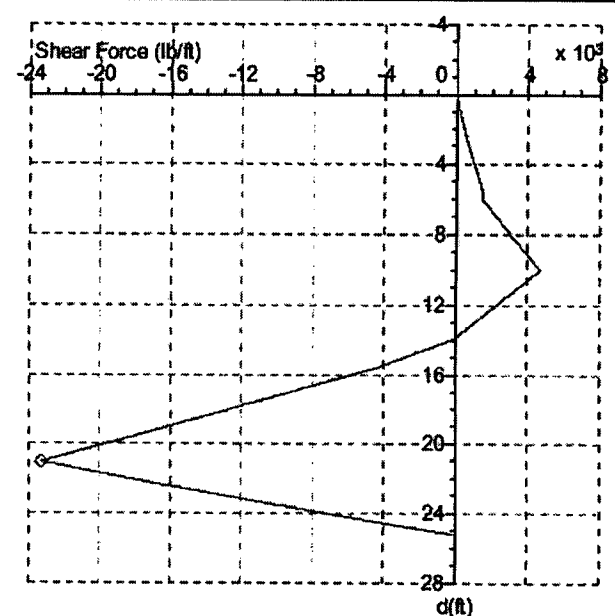
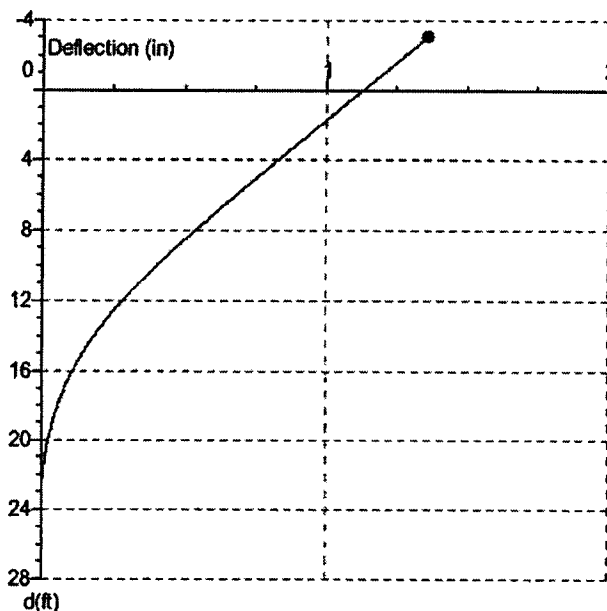
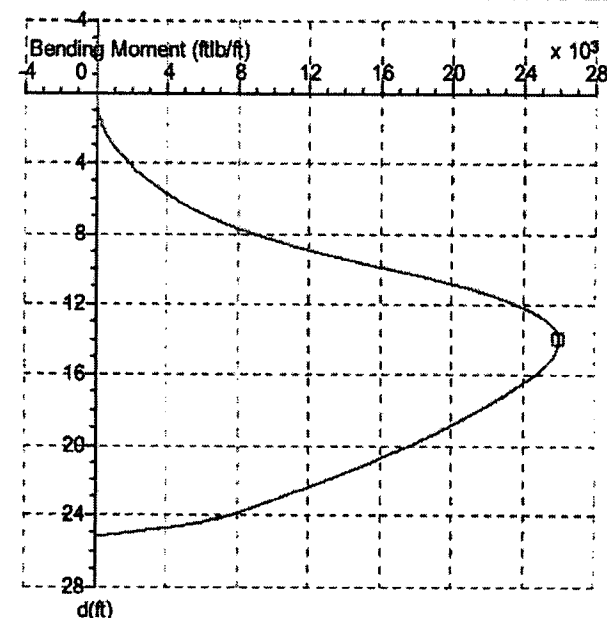
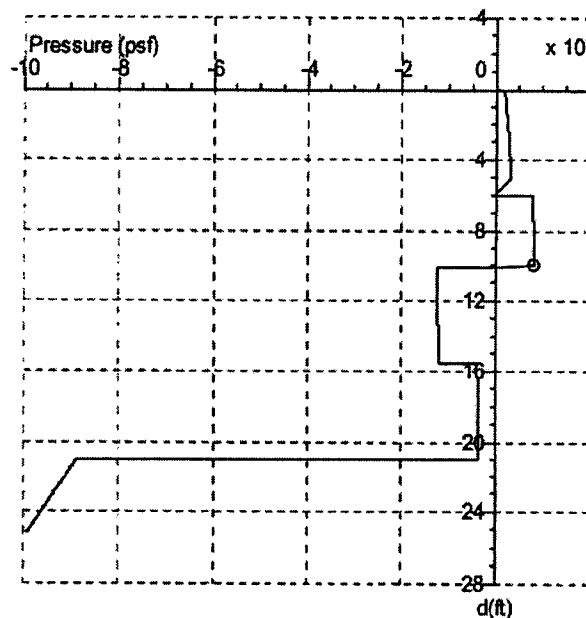
Designer: David Kun Li
Page: 3
Date: 9.13.06

Sheet: Arbed AZ18

Pressure: Coulomb
FOS: 1.0
Toe: Cantilever

	Maximum	d (ft)
○	820.7 psf	9.99
□	26032.8 ftlb/ft	13.89
◇	23210.9 lb/ft	21.03
●	1.4 in	-3.00

216 Paterson Plank Road Site,
Carlstadt, Bergen County, New Jersey
Project No.: 943-6222



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7/1/76

Client: 216 Paterson Plank Road Cooperating PRP Group																				
Title: Sheet Pile Wall Delsgn Section at RD-3-10% Slope Designer: David Kun Li Page: 4 Date: 9.13.06						depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)
Sheet: Arbed AZ18 Pressure: Coulomb FOS: 1.0 Toe: Cantilever						0.00	188.6	0.0	1.1	4.4	8.47	813.8	10639.0	0.5	3489.6	16.94	-366.4	23273.0	0.1	-9112.3
						0.22	196.6	5.8	1.1	49.8	8.69	814.8	11392.9	0.5	3661.7	17.16	-364.9	22910.7	0.1	-9922.5
						0.45	203.9	20.3	1.1	92.2	8.92	815.8	12273.3	0.5	3853.3	17.39	-363.5	22538.4	0.1	-10652.0
						0.67	211.9	47.1	1.1	141.1	9.14	816.8	13104.2	0.5	4025.9	17.61	-361.9	22156.2	0.1	-11463.0
						0.89	219.2	81.2	1.1	186.8	9.36	817.9	14070.2	0.4	4217.9	17.83	-360.6	21763.9	0.1	-12193.1
216 Paterson Plank Road Site, Carlstadt, Bergen County, New Jersey Project No.: 943-6222						1.11	227.2	130.6	1.0	239.3	9.59	818.8	14978.2	0.4	4390.9	18.06	-359.0	21361.7	0.1	-13004.7
						1.34	234.5	185.7	1.0	288.2	9.81	819.9	16030.0	0.4	4583.4	18.28	-357.6	21009.1	0.1	-13735.5
						1.56	242.5	259.3	1.0	344.3	10.03	-1236.0	17014.9	0.4	4690.2	18.50	-356.1	20588.5	0.0	-14547.8
						1.78	249.7	337.0	1.0	396.4	10.25	-1234.4	18086.0	0.4	4400.1	18.72	-354.7	20158.0	0.0	-15279.1
						2.01	257.8	436.4	1.0	456.1	10.48	-1233.0	18991.8	0.4	4139.3	18.95	-353.2	19717.7	0.0	-16092.1
						2.23	265.0	538.0	1.0	511.5	10.70	-1231.4	19933.6	0.4	3849.8	19.17	-351.8	19267.6	0.0	-16824.1
						2.45	273.1	664.8	0.9	574.8	10.92	-1229.9	20723.1	0.3	3589.7	19.39	-350.2	18807.8	0.0	-17637.8
						2.67	280.3	791.8	0.9	633.4	11.15	-1228.3	21535.8	0.3	3301.0	19.62	-348.9	18405.9	0.0	-18370.4
						2.90	288.4	947.6	0.9	700.2	11.37	-1226.9	22209.3	0.3	3041.5	19.84	-347.3	17927.9	0.0	-19184.8
						3.12	293.3	1101.4	0.9	761.9	11.59	-1225.3	22893.3	0.3	2753.5	20.06	-345.9	17440.3	0.0	-19918.0
						3.34	297.1	1287.7	0.9	831.3	11.81	-1223.8	23451.1	0.3	2494.6	20.29	-344.4	16943.0	0.0	-20733.0
						3.57	300.6	1469.4	0.9	894.5	12.04	-1222.2	24006.7	0.3	2207.3	20.51	-343.0	16436.1	0.0	-21466.9
						3.79	304.5	1687.0	0.8	965.6	12.26	-1220.8	24449.1	0.3	1949.1	20.73	-341.5	15919.5	0.0	-22282.6
						4.01	307.9	1897.3	0.8	1030.4	12.48	-1219.2	24876.7	0.3	1662.5	20.95	-340.1	15469.2	0.0	-23017.1
						4.24	311.8	2147.0	0.8	1103.2	12.71	-1217.7	25204.0	0.2	1404.9	21.18	-8922.7	14934.9	0.0	-22374.9
						4.46	315.3	2386.5	0.8	1169.5	12.93	-1216.1	25503.8	0.2	1119.1	21.40	-8975.5	14391.1	0.0	-21290.0
						4.68	318.7	2640.0	0.8	1236.6	13.15	-1214.7	25716.2	0.2	862.2	21.62	-9034.1	13837.8	0.0	-20071.6
						4.90	322.6	2938.4	0.8	1312.0	13.37	-1213.1	25888.6	0.2	577.0	21.85	-9086.8	13275.0	0.0	-18963.2
						5.13	280.1	3222.1	0.7	1377.1	13.60	-1211.6	25986.5	0.2	320.7	22.07	-9145.4	12702.8	0.0	-17718.6
						5.35	199.5	3551.9	0.7	1432.5	13.82	-1210.0	26031.8	0.2	36.3	22.29	-9198.1	12204.9	0.0	-16586.7
						5.57	127.0	3858.1	0.7	1466.1	14.04	-1208.6	26023.8	0.2	-387.8	22.51	-9256.7	11615.2	0.0	-15315.9
						5.80	46.4	4205.0	0.7	1485.5	14.27	-1207.0	25983.0	0.2	-1000.2	22.74	-9309.4	11016.2	0.0	-14160.5
						6.02	365.6	4519.4	0.7	1496.0	14.49	-1205.5	25922.1	0.2	-1551.7	22.96	-9368.0	10407.9	0.0	-12863.6
						6.24	803.6	4890.8	0.7	1684.7	14.71	-1203.9	25803.6	0.2	-2164.8	23.18	-9420.8	9790.3	0.0	-11684.6
						6.46	804.6	5262.9	0.7	1854.7	14.94	-1202.5	25686.8	0.1	-2717.0	23.41	-9479.4	9163.5	0.0	-10361.5
6.69	805.7	5718.6	0.6	2043.8	15.16	-1201.0	25520.3	0.1	-3269.4	23.63	-9532.1	8618.8	0.0	-9159.0						
6.91	806.6	6166.7	0.6	2214.3	15.38	-1199.4	25321.2	0.1	-3883.6	23.85	-9590.7	7967.7	0.0	-7809.8						
7.13	807.7	6707.0	0.6	2403.9	15.60	-375.2	25124.7	0.1	-4500.8	24.07	-9643.4	7140.9	0.0	-6583.7						
7.36	808.7	7231.2	0.6	2574.8	15.83	-373.6	24865.3	0.1	-5309.0	24.30	-9702.0	6072.7	0.0	-5208.4						
7.58	809.7	7856.2	0.6	2764.9	16.05	-372.3	24573.4	0.1	-6036.7	24.52	-9754.7	4761.9	0.0	-3958.8						
7.80	810.7	8456.8	0.6	2936.2	16.27	-370.7	24252.4	0.1	-6845.5	24.74	-9813.3	3207.5	0.0	-2557.3						
8.02	811.8	9166.7	0.5	3126.8	16.50	-369.3	23919.0	0.1	-7573.8	24.97	-9866.0	1680.4	0.0	-1284.2						
8.25	812.7	9843.9	0.5	3298.5	16.72	-367.8	23575.5	0.1	-8383.4	25.19	-9912.9	-27.3	0.0	0.0						

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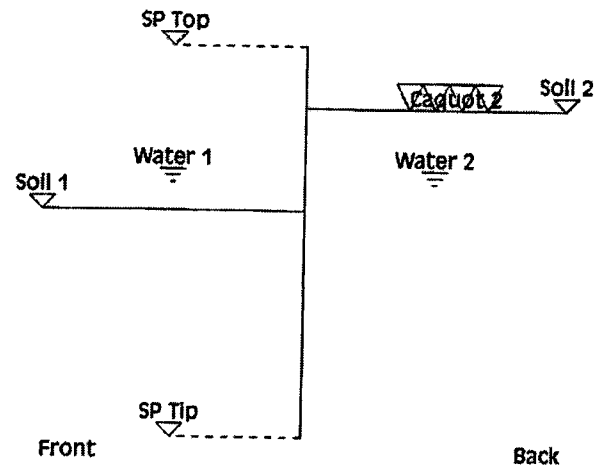
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Sheet Pile Design According to Blum-Method

Project Name: Sheet Pile Wall Design at RD-4
Date: 9/12/2006
Author: DKL
Company:
Comment:

Geodata

	Unit
Sheet Pile Top Level (ft)	-3.000
Sheet Pile Tip Level (ft)	16.112
Soil Level in Front (ft)	5.000
Soil Level behind (ft)	0.000
Anchor level (ft)	-3.000
Water Level in Front (ft)	3.000
Water Level behind (ft)	3.000
Soil Surface Inclination in Front (Deg)	0.000
Soil Surface Inclination behind (Deg)	0.000
Caquot Surcharge in Front (kip/ft ²)	0.000
Caquot Surcharge behind (kip/ft ²)	0.660
Anchor Inclination (Deg)	0.000
Earth Support	Cantilever



Soil Layers

Layers In Front

	Layer Tip [ft]	Density Moist [kip/ft ³]	Density Submerged [kip/ft ³]	Kph	Phi [Deg]	Delta [Deg]	Cohesion [kip/ft ²]
Layer 1	6.000	0.120	0.058	5.954	33.000	-16.500	0.000
Layer 2	9.000	0.110	0.048	1.000	0.000	0.000	0.200
Layer 3	22.000	0.120	0.058	1.000	0.000	0.000	0.600
Layer 4	35.000	0.115	0.053	1.000	0.000	0.000	0.400
Layer 5	40.000	0.120	0.058	4.216	28.000	-14.000	0.200

Layers behind

	Layer Tip [ft]	Density Moist [kip/ft ³]	Density Submerged [kip/ft ³]	Kph	Phi [Deg]	Delta [Deg]	Cohesion [kip/ft ²]
Layer 1	6.000	0.120	0.058	0.256	33.000	16.500	0.000
Layer 2	9.000	0.110	0.048	1.000	0.000	0.000	0.200
Layer 3	22.000	0.120	0.058	1.000	0.000	0.000	0.600
Layer 4	35.000	0.115	0.053	1.000	0.000	0.000	0.400
Layer 5	40.000	0.120	0.058	0.317	28.000	14.000	0.200

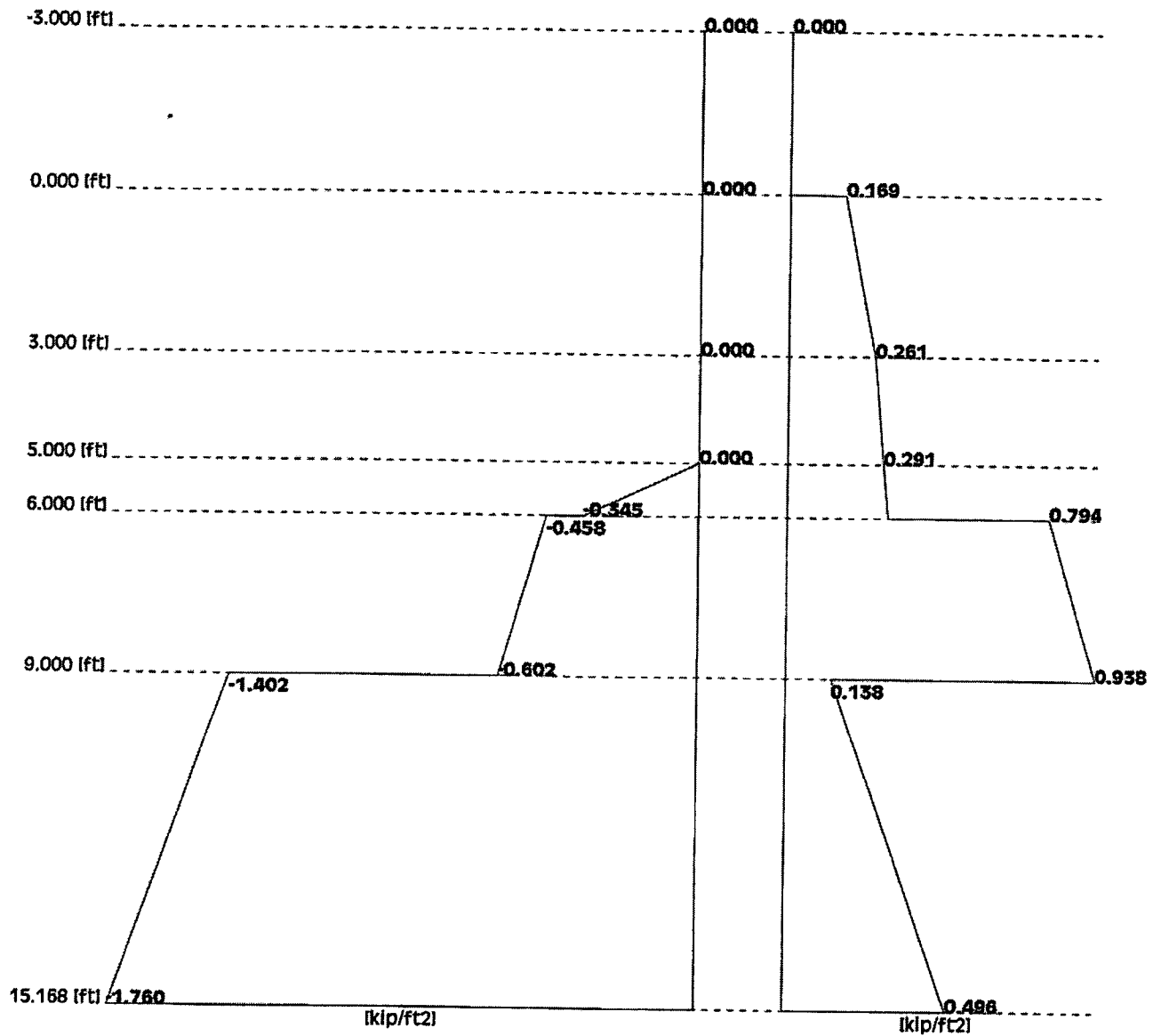
Pile Section

Name	AZ13-1
Inertia (in4/ft)	132.835
Modulus (in3/ft)	22.320
Area (in2/ft)	5.939
Mass (lbs/ft2)	20.215
Steel Grade (lb/in2)	34795.867
Requested Safety	1.500

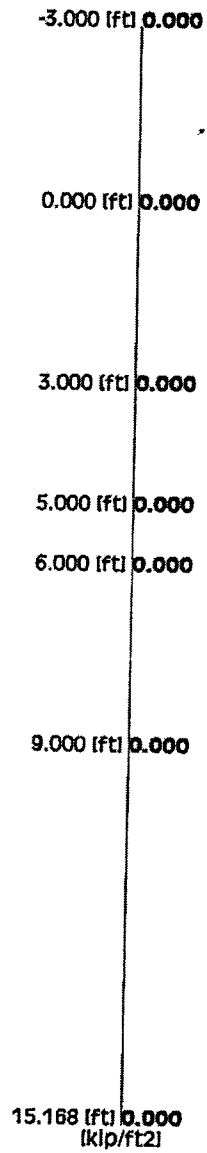
Pile Check

		Depth (ft)
Name	AZ13-1	
Inertia (in ⁴ /ft)	132.835	
Modulus (in ³ /ft)	22.320	
Area (in ² /ft)	5.939	
Mass (lbs/ft ²)	20.215	
Steel Grade (lb/in ²)	34795.867	
Minimal Moment (kip-ft/ft)	-0.343	15.201
Maximal Moment (kip-ft/ft)	11.625	10.640
Normal Forces at Max. Moment (kip/ft)	0.392	15.201
Normal Forces at Min. Moment (kip/ft)	0.392	10.640
Deflection at Min. Moment (ft)	0.000	15.201
Deflection at Max. Moment (ft)	-0.003	10.640
Min. Stress at Min. Moment (lb/in ²)	-118.520	15.201
Max. Stress at Min. Moment (lb/in ²)	250.522	15.201
Min. Stress at Max. Moment (lb/in ²)	-6184.492	10.640
Max. Stress at Max. Moment (lb/in ²)	6316.495	10.640
Safety > Req. Safety = 1.500	5.509	
Sheet Pile Top Level (ft)	-3.000	
Sheet Pile Tip Level (ft)	16.112	
Sheet Pile Length (ft)	19.112	
Included OverLength (ft)	0.944	
Vertical Equilibrium (kip/ft)	0.392	
Anchor Force (horiz.) (kip/ft)	0.000	

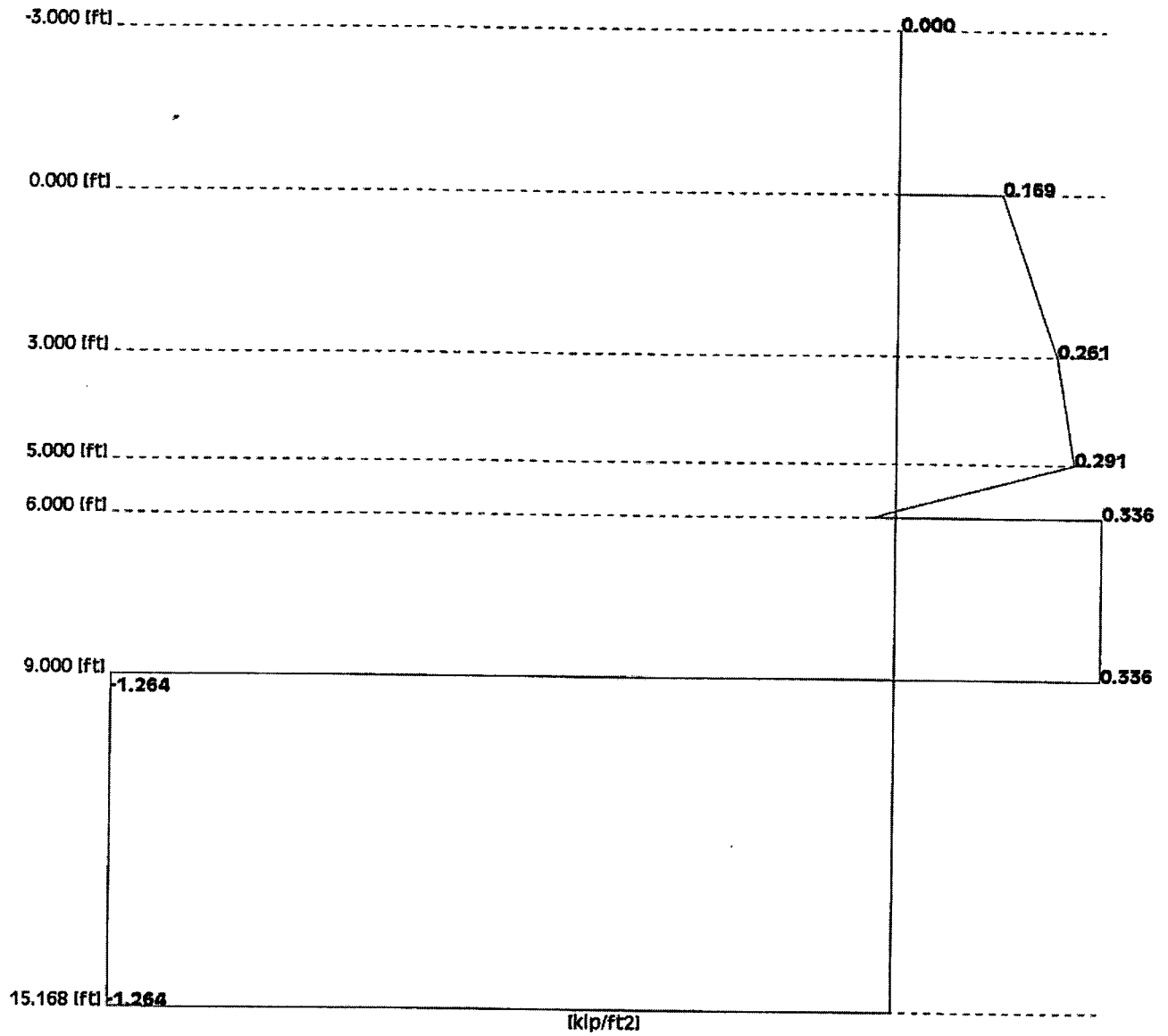
Earth Pressure Diagram



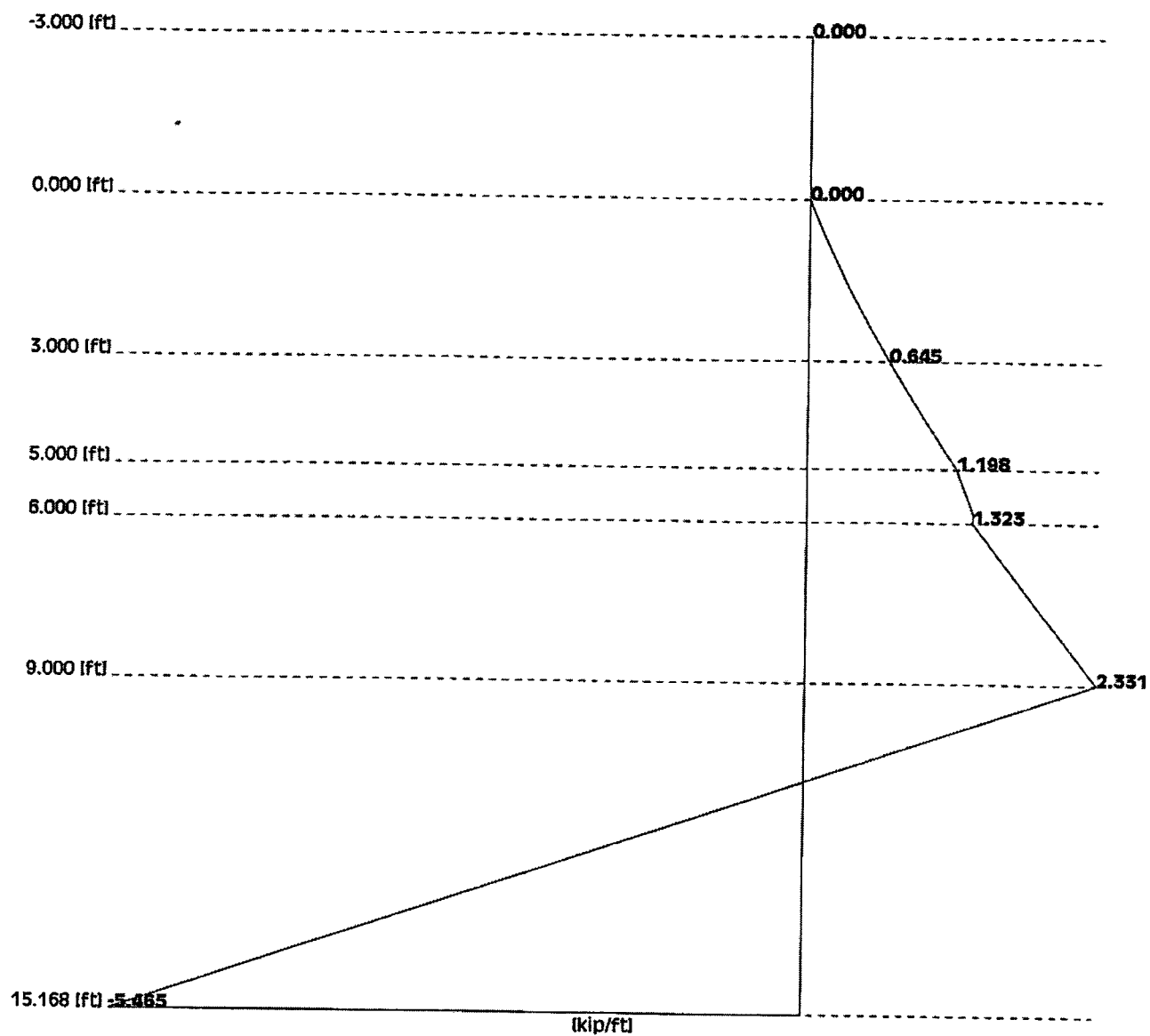
Water Pressure Diagram



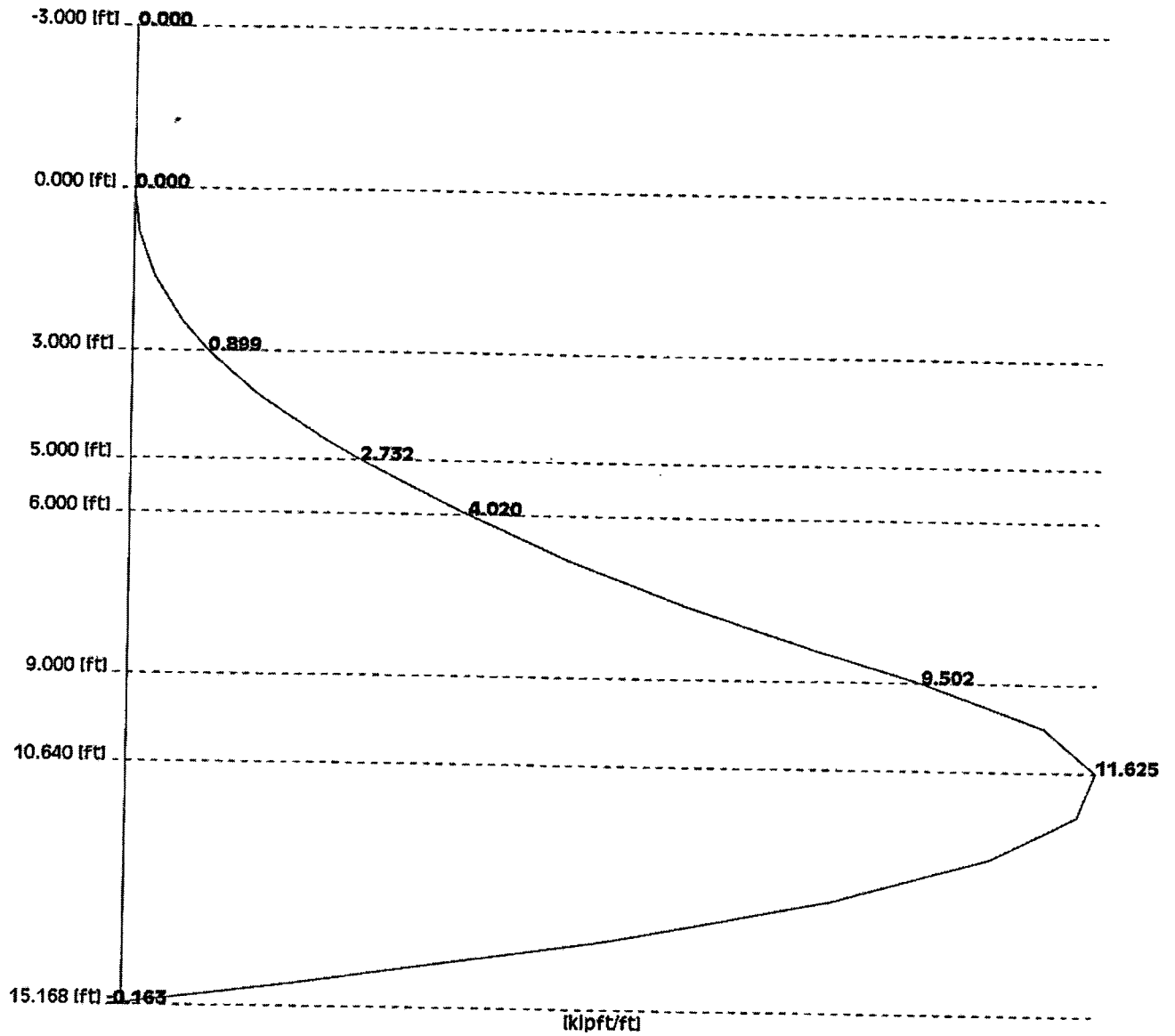
Total Pressure Diagram



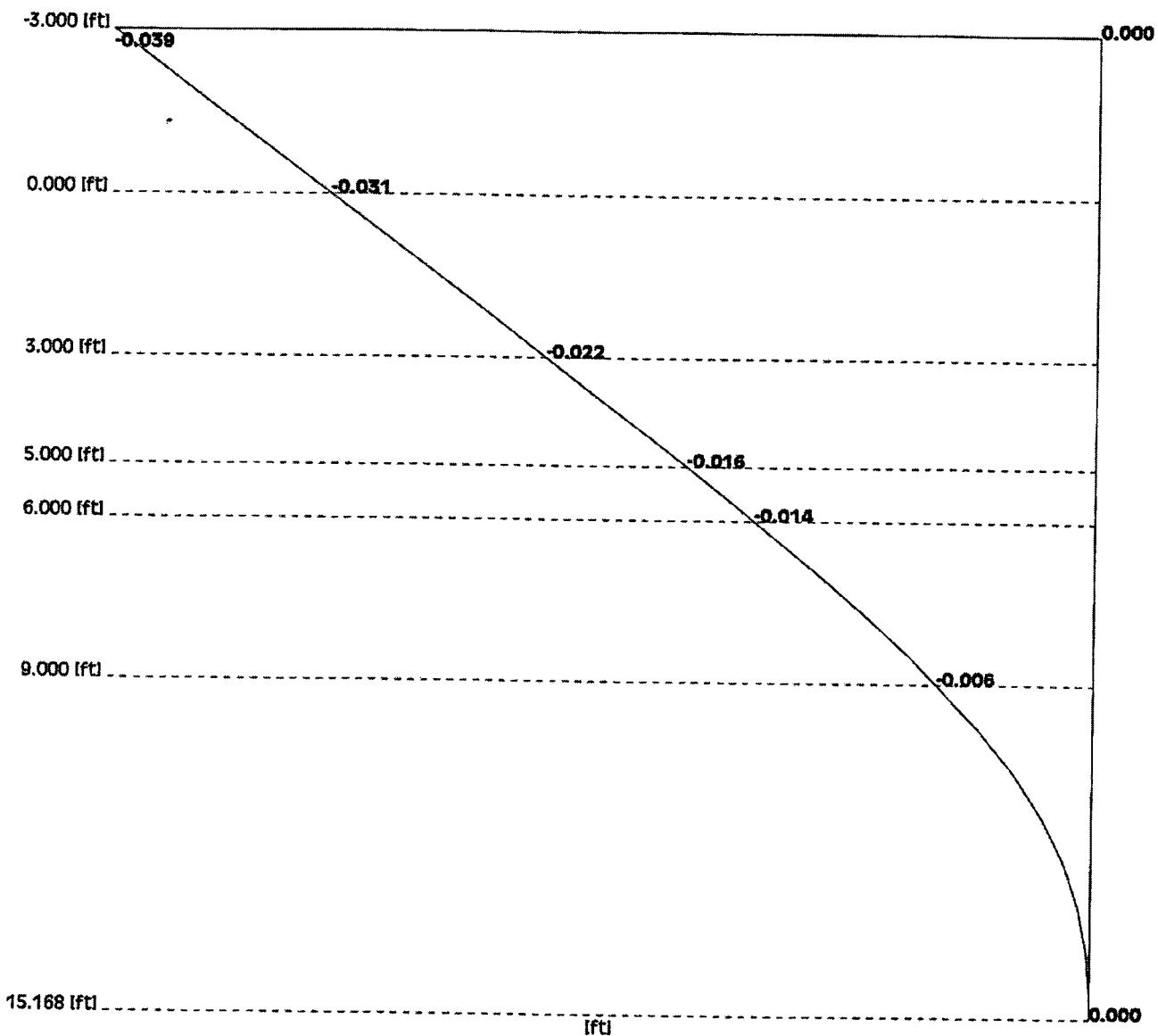
Cross Force Diagram



Moment Diagram

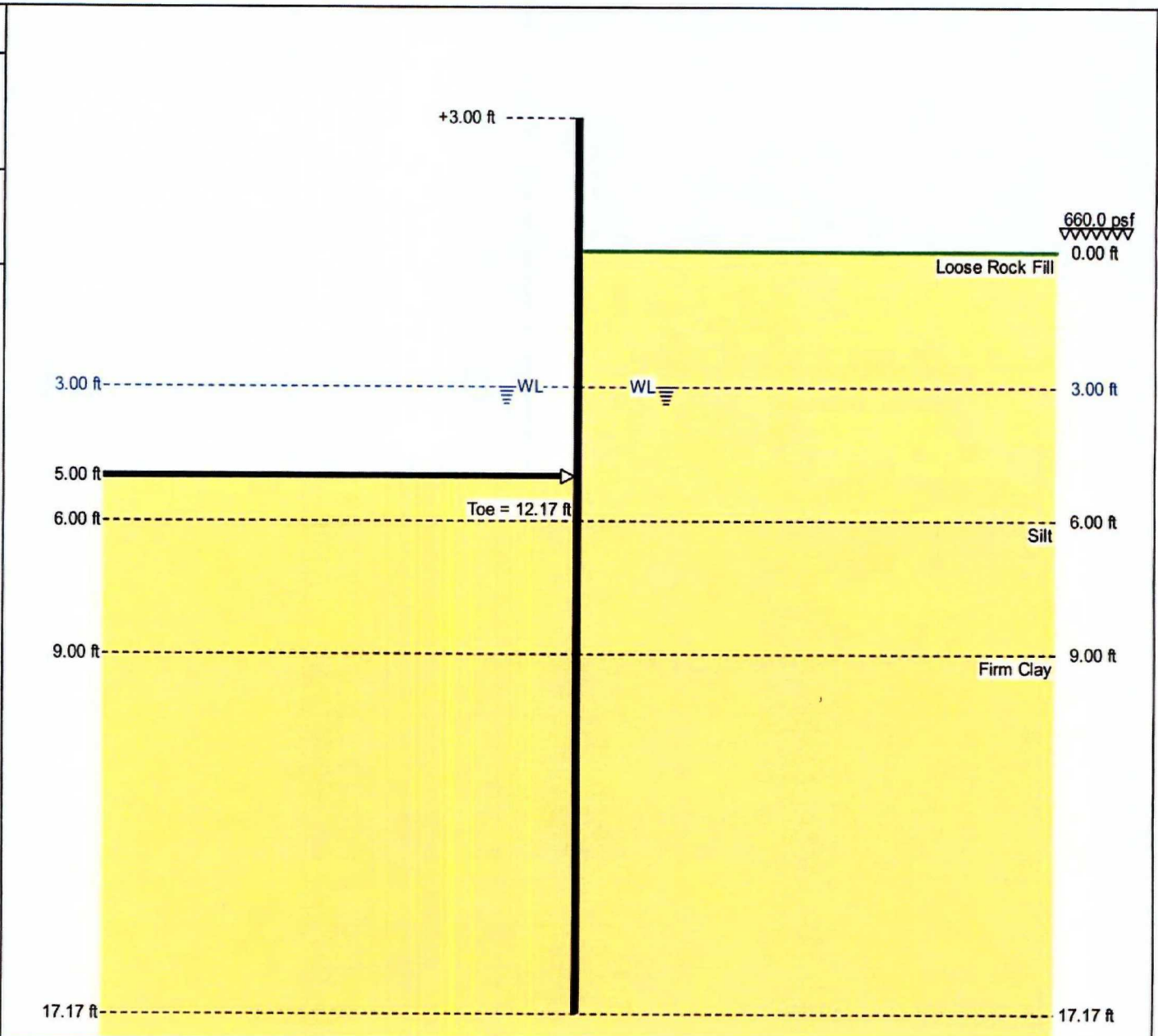


Deflection Diagram



23/90

Client: 216 Paterson Plank Road Cooperating PRP Group
Title: Sheet Pile Wall Design Section at RD-4
Designer: David Kun Li
Page: 1
Date: 9.13.06
Sheet: Arbed AZ18
Pressure: Coulomb
FOS: 1.0
Toe: Cantilever
216 Paterson Plank Road Site, Carlstadt, Bergen County, New Jersey Project No.: 943-6222



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24/19

Client: 216 Paterson Plank Road
Cooperating PRP Group

Title: Sheet Pile Wall Design Section
at RD-4

Designer: David Kun Li
Page: 2
Date: 9.13.06

Sheet: Arbed AZ18
Pressure: Coulomb
FOS: 1.0
Toe: Cantilever

216 Paterson Plank Road Site,
Carlstadt, Bergen County, New Jersey
Project No.: 943-6222

Input Data

Depth Of Excavation = 5.00 ft Depth Of Active Water = 3.00 ft Water Density = 62.37 pcf
Surcharge = 660.0 psf Depth Of Passive Water = 3.00 ft Minimum Fluid Density = 31.82 pcf

Soil Profile

Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}
0.00	Loose Rock Fill	120.00	57.60	0.0	0.0	33.0	16.5	0.27	0.00	6.24	0.00
6.00	Silt	110.00	47.60	200.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00
9.00	Firm Clay	120.00	57.60	600.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00
22.00	Soft Clay	115.00	52.60	400.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00
35.00	Sandy Clay	120.00	57.60	200.0	0.0	28.0	14.0	0.33	1.14	4.33	4.16

Solution

Sheet

Sheet Name	I (in ⁴ /ft)	E (psi)	Z (in ³ /ft)	f (psi)	Maximum Bending Moment (ftlb/ft)	Upstand (ft)	Toe (ft)	Pile Length (ft)
Arbed AZ18	250.40	3.04E+07	33.50	25000.0	69708.5	3.00	12.17	20.17

Maxima

	Maximum	Depth
Pressure	335.2 psf	7.57 ft

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25/90

Client: 216 Paterson Plank Road
Cooperating PRP Group

Title: Sheet Pile Wall Design Section
at RD-4

Designer: David Kun Li

Page: 3

Date: 9.13.06

Sheet: Arbed AZ18

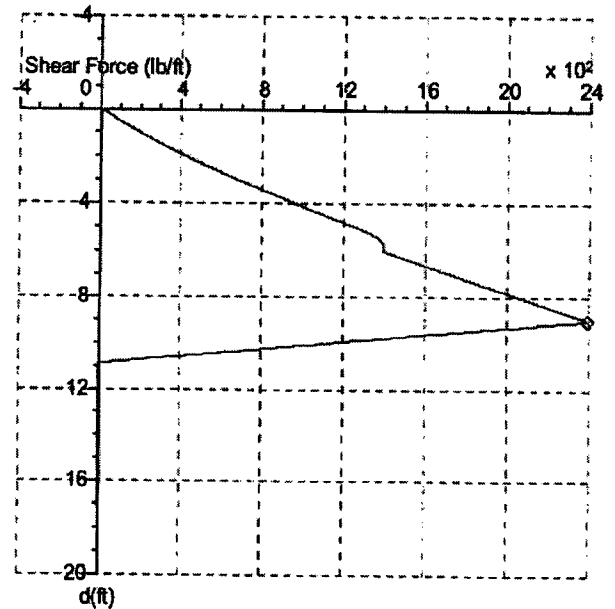
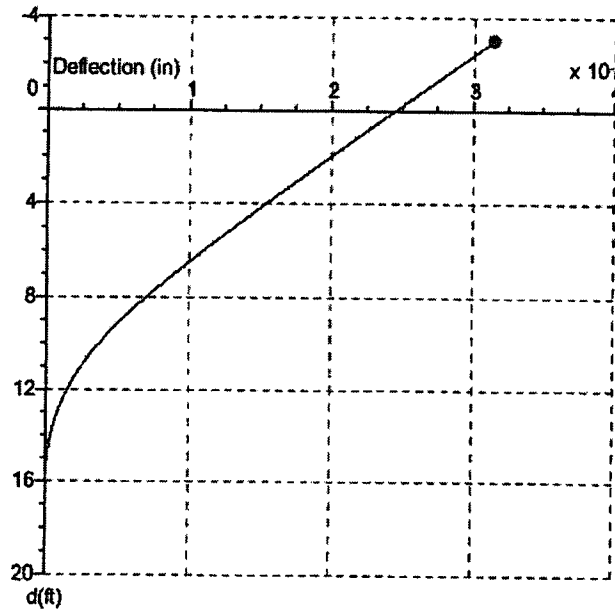
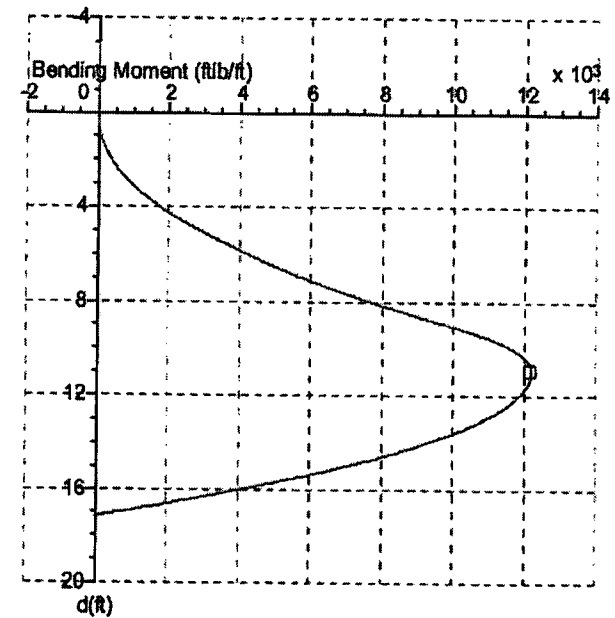
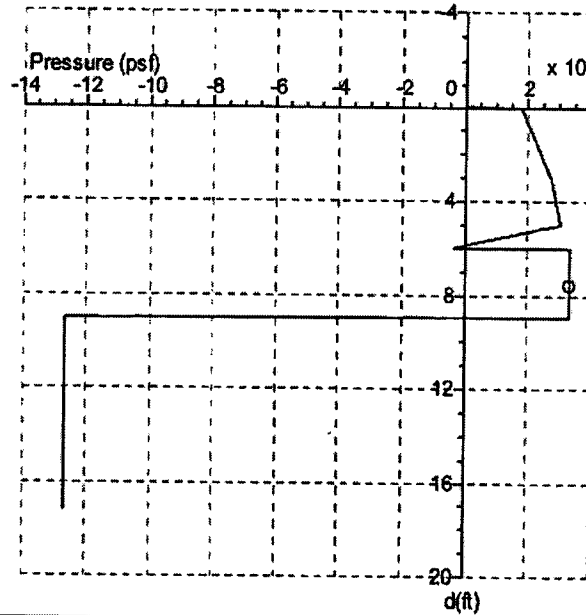
Pressure: Coulomb

FOS: 1.0

Toe: Cantilever

	Maximum	d (ft)
○	335.2 psf	7.57
□	12220.7 ftlb/ft	10.90
◇	2396.3 lb/ft	9.00
●	0.3 in	-3.00

216 Paterson Plank Road Site,
Carlstadt, Bergen County, New Jersey
Project No.: 943-6222



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86/90

Client: 216 Paterson Plank Road
Cooperating PRP Group

Title: Sheet Pile Wall Design Section
at RD-4
Designer: David Kun Li
Page: 4
Date: 9.13.06

Sheet: Arbed AZ18
Pressure: Coulomb
FOS: 1.0
Toe: Cantilever

216 Paterson Plank Road Site,
Carlstadt, Bergen County, New Jersey
Project No.: 943-6222

depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)
0.00	178.5	0.0	0.2	3.0	5.78	39.7	3924.0	0.1	1396.8	11.55	-1264.8	12092.3	0.0	-5.8
0.15	183.4	2.3	0.2	30.4	5.93	-18.2	4159.0	0.1	1398.1	11.70	-1264.8	12016.4	0.0	-5.6
0.30	188.3	8.8	0.2	58.6	6.08	335.2	4371.5	0.1	1426.6	11.86	-1264.8	11937.5	0.0	-5.5
0.46	193.2	19.6	0.2	87.5	6.23	335.2	4590.8	0.1	1477.3	12.01	-1264.8	11845.7	0.0	-5.3
0.61	198.1	34.8	0.2	117.1	6.38	335.2	4817.7	0.1	1528.1	12.16	-1264.8	11722.3	0.0	-5.2
0.76	203.0	54.6	0.2	147.5	6.54	335.2	5052.3	0.1	1578.8	12.31	-1264.8	11602.6	0.0	-5.0
0.91	207.9	79.0	0.2	178.7	6.69	335.2	5294.6	0.1	1629.5	12.46	-1264.8	11470.0	0.0	-4.8
1.06	212.8	108.1	0.2	210.5	6.84	335.2	5544.6	0.1	1680.2	12.62	-1264.8	11299.1	0.0	-4.7
1.22	217.7	142.2	0.2	243.1	6.99	335.2	5802.2	0.1	1730.9	12.77	-1264.8	11138.7	0.0	-4.5
1.37	222.6	181.2	0.2	276.5	7.14	335.2	6067.5	0.1	1781.7	12.92	-1264.8	10965.3	0.0	-4.4
1.52	227.5	225.3	0.2	310.6	7.30	335.2	6340.5	0.1	1832.4	13.07	-1264.8	10746.9	0.0	-4.2
1.67	232.4	274.6	0.2	345.4	7.45	335.2	6621.2	0.1	1883.1	13.22	-1264.8	10545.7	0.0	-4.1
1.82	237.3	329.3	0.2	381.0	7.60	335.2	6909.5	0.1	1933.8	13.37	-1264.8	10331.6	0.0	-3.9
1.98	242.2	389.4	0.2	417.3	7.75	335.2	7205.5	0.1	1984.5	13.53	-1264.8	10065.6	0.0	-3.7
2.13	247.7	462.6	0.2	458.6	7.90	335.2	7509.2	0.1	2035.3	13.68	-1264.8	9782.1	0.0	-3.6
2.28	252.6	534.6	0.2	496.5	8.06	335.2	7820.6	0.1	2086.0	13.83	-1264.8	9525.1	0.0	-3.4
2.43	257.5	612.3	0.2	535.1	8.21	335.2	8139.6	0.1	2136.7	13.98	-1264.8	9209.0	0.0	-3.3
2.58	262.4	695.9	0.2	574.5	8.36	335.2	8466.3	0.1	2187.4	14.13	-1264.8	8924.2	0.0	-3.1
2.74	267.3	785.5	0.2	614.6	8.51	335.2	8800.7	0.1	2238.1	14.29	-1264.8	8626.5	0.0	-3.0
2.89	272.2	881.2	0.2	655.4	8.66	335.2	9142.8	0.1	2288.8	14.44	-1264.8	8262.9	0.0	-2.8
3.04	276.2	983.2	0.2	697.0	8.82	335.2	9492.5	0.1	2339.6	14.59	-1264.8	7937.3	0.0	-2.7
3.19	278.6	1091.5	0.2	739.0	8.97	335.2	9849.9	0.1	2390.3	14.74	-1264.8	7598.8	0.0	-2.5
3.34	280.9	1206.1	0.2	781.3	9.12	-1264.8	10204.9	0.1	2247.5	14.89	-1264.8	7187.6	0.0	-2.3
3.50	283.3	1327.2	0.2	824.0	9.27	-1264.8	10532.1	0.0	2056.1	15.05	-1264.8	6821.3	0.0	-2.2
3.65	285.6	1454.8	0.2	867.1	9.42	-1264.8	10830.3	0.0	1864.7	15.20	-1264.8	6442.1	0.0	-2.0
3.80	288.0	1588.9	0.2	910.5	9.58	-1264.8	11099.6	0.0	1673.4	15.35	-1264.8	5983.4	0.0	-1.9
3.95	290.3	1729.6	0.2	954.3	9.73	-1264.8	11384.8	0.0	1460.7	15.50	-1264.8	5576.3	0.0	-1.7
4.10	292.7	1877.0	0.2	998.4	9.88	-1264.8	11573.0	0.0	1269.4	15.65	-1264.8	5156.3	0.0	-1.6
4.26	295.0	2031.0	0.1	1042.9	10.03	-1264.8	11752.2	0.0	1078.0	15.81	-1264.8	4650.0	0.0	-1.4
4.41	297.4	2191.8	0.1	1087.7	10.18	-1264.8	11902.4	0.0	886.6	15.96	-1264.8	4202.2	0.0	-1.3
4.56	299.7	2359.4	0.1	1132.9	10.34	-1264.8	12023.7	0.0	695.3	16.11	-1264.8	3741.4	0.0	-1.1
4.71	302.1	2533.9	0.1	1178.5	10.49	-1264.8	12116.0	0.0	503.9	16.26	-1264.8	3187.6	0.0	-0.9
4.86	304.5	2715.3	0.1	1224.4	10.64	-1264.8	12179.4	0.0	312.5	16.41	-1264.8	2698.9	0.0	-0.8
5.02	299.8	2903.7	0.1	1270.5	10.79	-1264.8	12213.8	0.0	121.1	16.57	-1264.8	2197.4	0.0	-0.6
5.17	247.8	3098.8	0.1	1311.5	10.94	-1264.8	12220.1	0.0	-6.4	16.72	-1264.8	1596.0	0.0	-0.5
5.32	195.8	3299.6	0.1	1344.6	11.10	-1264.8	12209.8	0.0	-6.3	16.87	-1264.8	1066.6	0.0	-0.3
5.47	143.7	3504.8	0.1	1369.9	11.25	-1264.8	12181.5	0.0	-6.1	17.02	-1264.8	524.4	0.0	-0.2
5.62	91.7	3713.3	0.1	1387.3	11.40	-1264.8	12143.3	0.0	-5.9	17.17	-1264.8	-30.8	0.0	0.0

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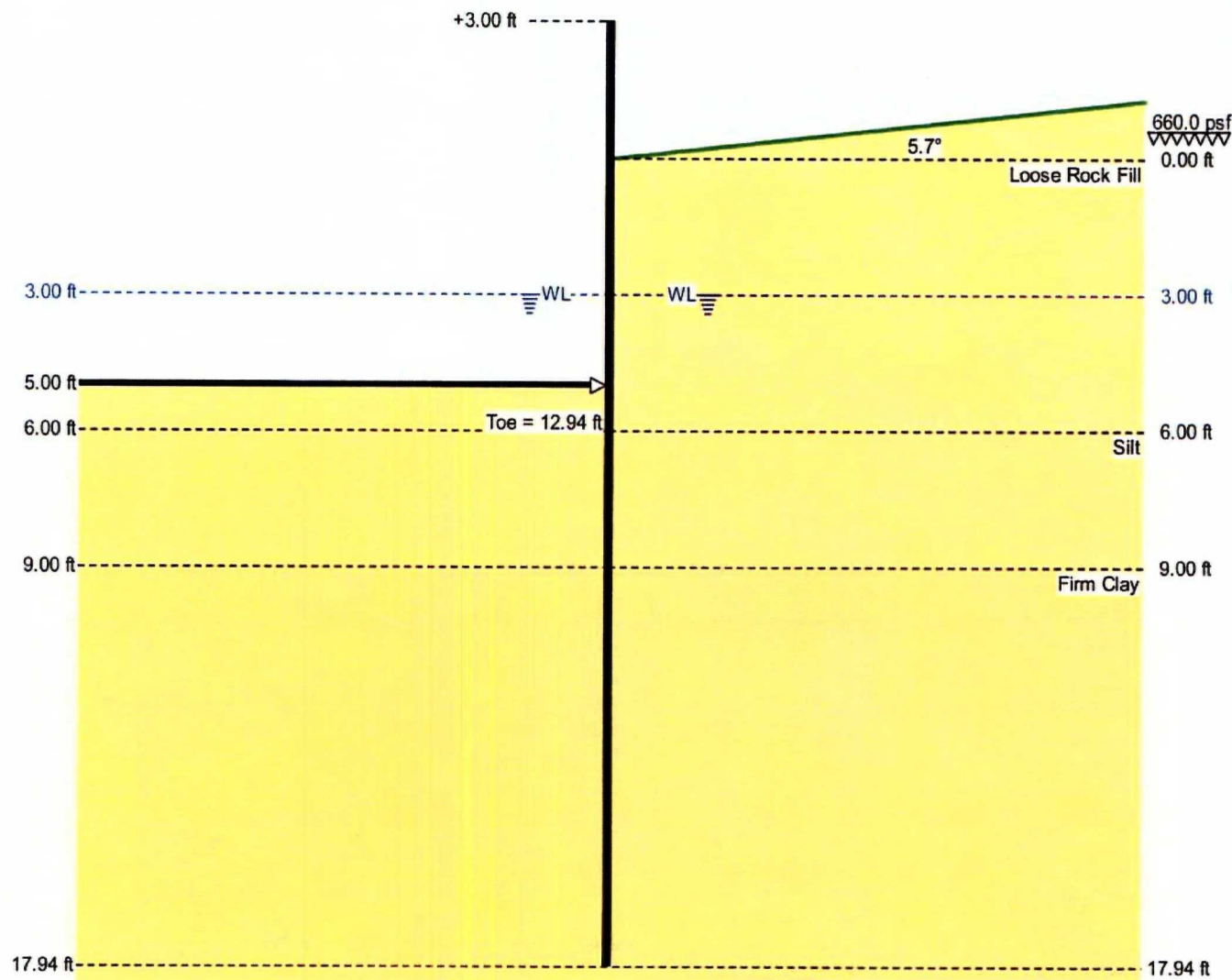
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Client: 216 Paterson Plank Road Cooperating PRP Group
Title: Sheet Pile Wall Design Section at RD-4-10% Slope
Designer: David Kun Li
Page: 1
Date: 9.13.06
Sheet: Arbed AZ18
Pressure: Coulomb
FOS: 1.0
Toe: Cantilever
216 Paterson Plank Road Site, Carlstadt, Bergen County, New Jersey Project No.: 943-6222



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<p>Client: 216 Paterson Plank Road Cooperating PRP Group</p> <p>Title: Sheet Pile Wall Design Section at RD-4-10% Slope</p> <p>Designer: David Kun Li</p> <p>Page: 2</p> <p>Date: 9.13.06</p> <p>Sheet: Arbed AZ18</p> <p>Pressure: Coulomb</p> <p>FOS: 1.0</p> <p>Toe: Cantilever</p> <p>216 Paterson Plank Road Site, Carlstadt, Bergen County, New Jersey</p> <p>Project No.: 943-6222</p>	<div style="text-align: right; margin-bottom: 10px;"><u>Input Data</u></div> <p>Depth Of Excavation = 5.00 ft Depth Of Active Water = 3.00 ft Water Density = 62.37 pcf</p> <p>Surcharge = 660.0 psf Depth Of Passive Water = 3.00 ft Minimum Fluid Density = 31.82 pcf</p> <p>Slope (active) = 5.7 degrees</p> <p><u>Soil Profile</u></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Depth (ft)</th> <th>Soil Name</th> <th>γ (pcf)</th> <th>γ' (pcf)</th> <th>C (psf)</th> <th>C_a (psf)</th> <th>ϕ (°)</th> <th>δ (°)</th> <th>K_a</th> <th>K_{ac}</th> <th>K_p</th> <th>K_{pc}</th> </tr> </thead> <tbody> <tr> <td>0.00</td> <td>Loose Rock Fill</td> <td>120.00</td> <td>57.60</td> <td>0.0</td> <td>0.0</td> <td>33.0</td> <td>16.5</td> <td>0.27</td> <td>0.00</td> <td>6.24</td> <td>0.00</td> </tr> <tr> <td>6.00</td> <td>Silt</td> <td>110.00</td> <td>47.60</td> <td>200.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>1.00</td> <td>2.00</td> <td>1.00</td> <td>2.00</td> </tr> <tr> <td>9.00</td> <td>Firm Clay</td> <td>120.00</td> <td>57.60</td> <td>600.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>1.00</td> <td>2.00</td> <td>1.00</td> <td>2.00</td> </tr> <tr> <td>22.00</td> <td>Soft Clay</td> <td>115.00</td> <td>52.60</td> <td>400.0</td> <td>0.0</td> <td>0.0</td> <td>0.0</td> <td>1.00</td> <td>2.00</td> <td>1.00</td> <td>2.00</td> </tr> <tr> <td>35.00</td> <td>Sandy Clay</td> <td>120.00</td> <td>57.60</td> <td>200.0</td> <td>0.0</td> <td>28.0</td> <td>14.0</td> <td>0.33</td> <td>1.14</td> <td>4.33</td> <td>4.16</td> </tr> </tbody> </table> <div style="text-align: right; margin-top: 20px;"><u>Solution</u></div> <p><u>Sheet</u></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Sheet Name</th> <th>I (in⁴/ft)</th> <th>E (psi)</th> <th>Z (in³/ft)</th> <th>f (psi)</th> <th>Maximum Bending Moment (ft-lb/ft)</th> <th>Upstand (ft)</th> <th>Toe (ft)</th> <th>Pile Length (ft)</th> </tr> </thead> <tbody> <tr> <td>Arbed AZ18</td> <td>250.40</td> <td>3.04E+07</td> <td>33.50</td> <td>25000.0</td> <td>69708.5</td> <td>3.00</td> <td>12.94</td> <td>20.94</td> </tr> </tbody> </table> <p><u>Maxima</u></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Maximum</th> <th>Depth</th> </tr> </thead> <tbody> <tr> <td>Pressure</td> <td>409.9 psf</td> <td>8.99 ft</td> </tr> </tbody> </table>	Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}	0.00	Loose Rock Fill	120.00	57.60	0.0	0.0	33.0	16.5	0.27	0.00	6.24	0.00	6.00	Silt	110.00	47.60	200.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00	9.00	Firm Clay	120.00	57.60	600.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00	22.00	Soft Clay	115.00	52.60	400.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00	35.00	Sandy Clay	120.00	57.60	200.0	0.0	28.0	14.0	0.33	1.14	4.33	4.16	Sheet Name	I (in ⁴ /ft)	E (psi)	Z (in ³ /ft)	f (psi)	Maximum Bending Moment (ft-lb/ft)	Upstand (ft)	Toe (ft)	Pile Length (ft)	Arbed AZ18	250.40	3.04E+07	33.50	25000.0	69708.5	3.00	12.94	20.94		Maximum	Depth	Pressure	409.9 psf	8.99 ft
Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}																																																																																						
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9.00	Firm Clay	120.00	57.60	600.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00																																																																																						
22.00	Soft Clay	115.00	52.60	400.0	0.0	0.0	0.0	1.00	2.00	1.00	2.00																																																																																						
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Client: 216 Paterson Plank Road
Cooperating PRP Group

Title: Sheet Pile Wall Design Section
at RD-4-10% Slope

Designer: David Kun Li

Page: 3

Date: 9.13.06

Sheet: Arbed AZ18

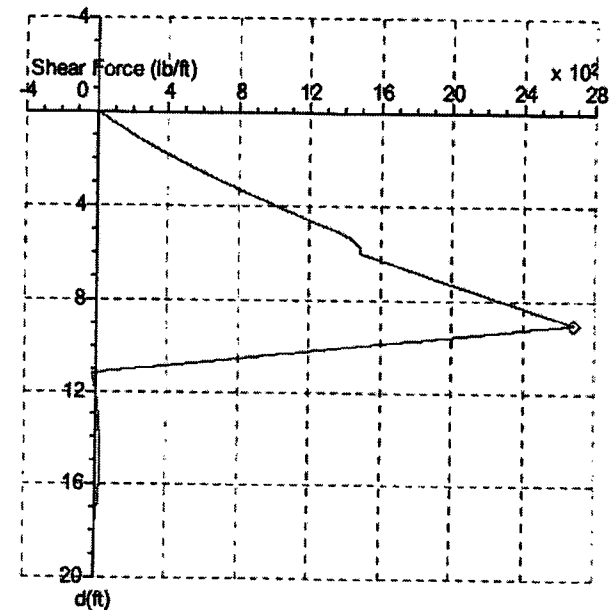
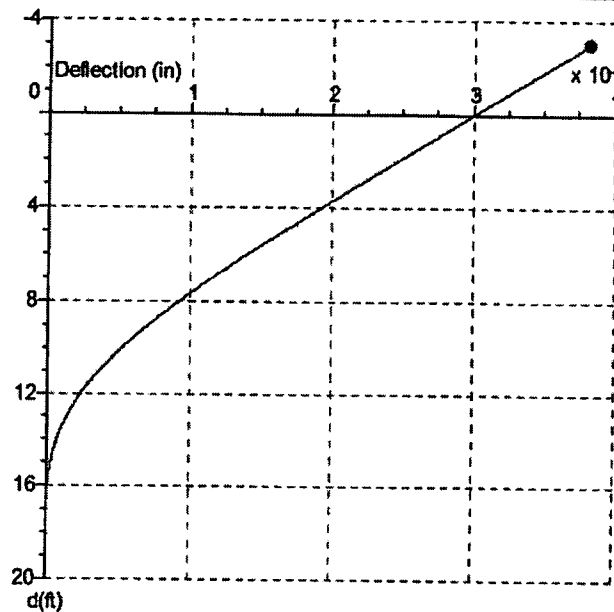
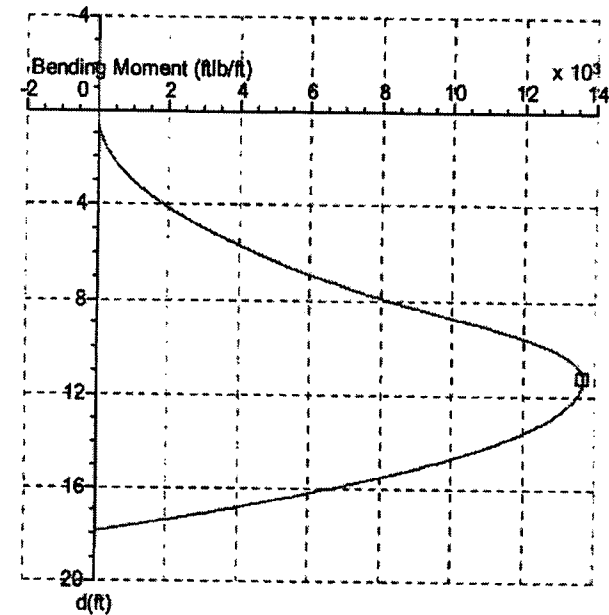
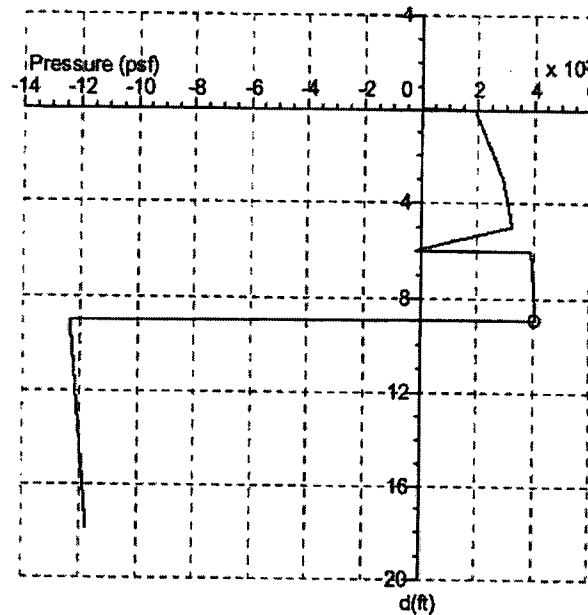
Pressure: Coulomb

FOS: 1.0

Toe: Cantilever

	Maximum	d (ft)
○	409.9 psf	8.99
□	13697.0 ftlb/ft	11.20
◇	2685.6 lb/ft	9.00
●	0.4 in	-3.00

216 Paterson Plank Road Site,
Carlstadt, Bergen County, New Jersey
Project No.: 943-6222



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9/9/90

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0.00	188.4	0.0	0.3	3.3	6.03	391.3	4548.3	0.1	1502.5	12.06	-1214.7	13467.5	0.0	4.8
0.16	194.4	3.2	0.3	36.7	6.19	392.3	4788.5	0.1	1564.1	12.22	-1213.6	13367.1	0.0	7.7
0.32	199.7	11.1	0.3	67.7	6.35	393.3	5038.4	0.1	1625.7	12.38	-1212.5	13266.6	0.0	10.5
0.48	205.1	23.9	0.3	99.6	6.51	394.3	5298.0	0.1	1687.6	12.54	-1211.5	13152.8	0.0	13.1
0.63	210.5	41.8	0.3	132.2	6.67	395.3	5597.8	0.1	1758.5	12.70	-1210.4	13003.2	0.0	15.5
0.79	215.9	64.9	0.3	165.8	6.83	396.3	5878.0	0.1	1818.6	12.86	-1209.3	12860.6	0.0	17.8
0.95	221.3	93.4	0.3	200.1	6.98	397.3	6167.9	0.1	1881.0	13.02	-1208.3	12677.5	0.0	19.8
1.11	226.6	127.2	0.3	235.3	7.14	398.3	6467.6	0.1	1943.4	13.17	-1207.1	12476.2	0.0	22.0
1.27	232.0	166.7	0.3	271.4	7.30	399.3	6777.1	0.1	2006.1	13.33	-1206.0	12289.3	0.0	23.7
1.43	237.4	211.9	0.3	308.3	7.46	400.3	7096.5	0.1	2068.8	13.49	-1204.9	12089.2	0.0	25.3
1.59	242.8	262.9	0.3	346.0	7.62	401.3	7425.7	0.1	2131.8	13.65	-1203.8	11838.9	0.0	26.7
1.75	248.7	326.6	0.3	389.0	7.78	402.2	7764.9	0.1	2194.9	13.81	-1202.8	11610.1	0.0	27.9
1.90	254.1	390.4	0.2	428.5	7.94	403.2	8113.9	0.1	2258.1	13.97	-1201.7	11326.3	0.0	29.0
2.06	259.5	460.5	0.2	468.9	8.10	404.2	8472.9	0.1	2321.5	14.13	-1200.6	11068.8	0.0	29.9
2.22	264.9	537.0	0.2	510.1	8.25	405.3	8883.5	0.1	2392.1	14.29	-1199.5	10798.1	0.0	30.6
2.38	270.3	620.0	0.2	552.1	8.41	406.3	9263.6	0.1	2455.9	14.44	-1198.5	10465.5	0.0	31.1
2.54	275.6	709.7	0.2	595.0	8.57	407.3	9653.7	0.1	2519.8	14.60	-1197.4	10168.1	0.0	31.5
2.70	281.0	806.2	0.2	638.8	8.73	408.3	10053.8	0.1	2583.8	14.76	-1196.2	9800.2	0.0	31.7
2.86	286.4	909.6	0.2	683.4	8.89	409.2	10464.0	0.1	2648.0	14.92	-1195.1	9416.3	0.0	31.8
3.02	291.4	1020.1	0.2	728.8	9.05	-1235.3	10882.5	0.1	2621.0	15.08	-1194.0	9073.0	0.0	31.6
3.17	294.0	1137.7	0.2	774.8	9.21	-1234.3	11280.5	0.1	2427.1	15.24	-1193.0	8716.5	0.0	31.3
3.33	296.6	1262.6	0.2	821.2	9.37	-1233.2	11648.1	0.1	2233.4	15.40	-1191.9	8283.9	0.0	30.9
3.49	299.4	1410.0	0.2	873.2	9.52	-1232.1	11985.3	0.1	2039.8	15.56	-1190.8	7898.9	0.0	30.2
3.65	302.0	1550.4	0.2	920.5	9.68	-1231.0	12292.1	0.1	1846.4	15.71	-1189.8	7433.2	0.0	29.4
3.81	304.6	1698.3	0.2	968.1	9.84	-1229.9	12597.4	0.1	1631.8	15.87	-1188.7	7019.7	0.0	28.4
3.97	307.2	1853.6	0.2	1016.2	10.00	-1228.8	12840.1	0.1	1438.8	16.03	-1187.6	6593.1	0.0	27.3
4.13	309.8	2016.6	0.2	1064.6	10.16	-1227.7	13052.6	0.1	1245.9	16.19	-1186.5	6078.8	0.0	26.0
4.29	312.4	2187.1	0.2	1113.5	10.32	-1226.6	13234.8	0.0	1053.2	16.35	-1185.3	5546.6	0.0	24.3
4.44	314.9	2365.4	0.2	1162.8	10.48	-1225.6	13386.7	0.0	860.7	16.51	-1184.3	5076.3	0.0	22.6
4.60	317.5	2551.5	0.2	1212.4	10.64	-1224.5	13508.5	0.0	668.4	16.67	-1183.2	4511.1	0.0	20.8
4.76	320.1	2745.3	0.2	1262.5	10.79	-1223.4	13600.0	0.0	476.2	16.83	-1182.1	4012.4	0.0	18.8
4.92	322.7	2947.1	0.2	1313.0	10.95	-1222.3	13661.4	0.0	284.2	16.98	-1181.0	3500.7	0.0	16.6
5.08	291.2	3180.6	0.2	1367.6	11.11	-1221.3	13692.6	0.0	92.3	17.14	-1180.0	2887.2	0.0	14.2
5.24	237.3	3398.3	0.2	1408.7	11.27	-1220.2	13695.1	0.0	-12.9	17.30	-1178.9	2347.1	0.0	11.7
5.40	183.5	3621.9	0.2	1441.2	11.43	-1219.1	13681.4	0.0	-9.1	17.46	-1177.8	1700.6	0.0	9.0
5.56	129.6	3850.0	0.2	1465.3	11.59	-1217.9	13648.4	0.0	-5.0	17.62	-1176.7	1132.2	0.0	6.2
5.71	75.8	4081.2	0.1	1481.0	11.75	-1216.8	13597.3	0.0	-1.6	17.78	-1175.7	550.8	0.0	3.2
5.87	21.9	4314.4	0.1	1488.2	11.90	-1215.8	13539.1	0.0	1.7	17.94	-1174.7	-43.6	0.0	0.0

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APPENDIX G

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SECTION 00200

INFORMATION AVAILABLE TO BIDDERS

PART 1 – GENERAL

1.01 AVAILABLE REPORTS

- A. A number of documents related to historic remedial investigation, feasibility studies, and remedial activities for the 216 Paterson Plank Road Site are available for review. These documents are as follows:

1. Canonie Environmental, 1992. "Final Report Interim Remedy for First Operable Unit Scientific Chemical Processing Superfund Site at 216 Paterson Plank Road, Carlstadt, New Jersey," September 1992.
2. Canonie Environmental, 1991. "Interim Remedy Remedial Design Report," July 19, 1991.
3. Canonie Environmental, 1991. "Operations and Maintenance Plan".
4. Dames and Moore, 1990. "Final Report - Remedial Investigation SCP Site, Carlstadt, New Jersey," March 1, 1990.
5. Dames and Moore, 1989. "Test Pit Investigation SCP/Carlstadt July 1989," August 4, 1989.
6. Dames and Moore, 1988. "Revision No. 9, Project Operations Plan, SCP Site Remedial Investigation, Carlstadt, New Jersey," September 30, 1988.
7. Dames & Moore, 1988. "Revision No. 8 (Amended) Project Operations Plan, SCP Site Remedial Investigation, Carlstadt, New Jersey," September 30, 1988.
8. Environmental Resources Management, Inc., 1989. "Preliminary Feasibility Study for the First Operable Unit of the SCP/Carlstadt Site," July 1989.
9. Golder Associates Inc., 2005. "Revised Remedial Design Work Plan for Operable Unit 2", April 2005.
10. Golder Associates Inc., 2001. "Focused Feasibility Study Operable Unit 2 Final Remedy: Fill and Shallow Groundwater", April 2001.
11. Golder Associates Inc., 1997. "Focused Feasibility Investigation Report", November 1997.
12. Kiber Environmental Services, Inc. "216 Paterson Plank Road Site – Treatability Study – Final Report", July 2000.
13. Golder Associates Inc., 2005. "Preliminary (35% Design) Design Report", December 2005.

14. Golder Associates Inc., 2006. "Pre-Final (95% Design) Design Report", October 2006.
15. Golder Associates Inc., 2007. "Final Design Report", May, 2007.
16. USEPA, 2002. Record of Decision for the Final Remedy for Operable Unit No. 2 (OU-2), August 26, 2002.
17. USEPA, 2004. Consent Decree for Implementation of the Final Remedy for OU-2, lodged on July 14, 2004 and effective September 30, 2004.

- B. CONTRACTOR shall perform their own subsurface investigations, as necessary, after approval from GROUP, as necessary to complete design of excavation, shoring or other work. CONTRACTOR shall obtain the right to access private property located on the Site and shall assume all responsibility for any damage to property, including any third party damage claims, caused as a result of CONTRACTOR's investigation. CONTRACTOR shall be entirely responsible for the proper backfilling/sealing of test borings in accordance with applicable state and local regulations and for the proper handling and disposal of soil cuttings and/or samples.

1.02 DISCLAIMERS

- A. These reports and other information pertinent to the Site conditions may be reviewed at the offices of the REMEDIAL DESIGNER or designated public repositories.
- B. The Site subsurface conditions information provided in the referenced documents or other documents available for review, and not otherwise shown on the Contract Drawings, is not a part of the Contract Documents and is offered only as an aid in Bidding. The subsurface information is available for CONTRACTOR's information only and is not a warranty or guarantee of subsurface conditions. Neither the GROUP nor the REMEDIAL DESIGNER assumes any responsibility for any variation between subsurface materials encountered during construction and those indicated in the referenced information, including, but not limited to, any variation in the depth to groundwater, bedrock elevation, waste thickness, cover thickness, or any other variation.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

END OF SECTION

SECTION 01010

SUMMARY OF REMEDIAL WORK

PART 1 – GENERAL

1.01 SITE HISTORY

The Site is located at the intersection of Paterson Plank Road and Gotham Parkway in Carlstadt, Bergen County, New Jersey, and covers an area of about 6-acres. A chemical recycling and waste processing facility, which ceased operation in 1980, formerly occupied the Site. In 1983, the Site was placed on USEPA's National Priorities List (NPL). The Site is bordered to the southwest by Paterson Plank Road, to the northwest by Gotham Parkway, to the southeast by a trucking company, and to the northeast by Peach Island Creek.

Between 1987 and 2006, a number of field investigations and design studies were completed to evaluate soil and groundwater conditions beneath the Site. In broad terms, these investigations have revealed ground conditions comprising fill overlying a clay layer, which is in turn underlain by glacial till and bedrock.

Between August 1991 and June 1992, construction of an interim remedy for Operable Unit No. 1 (OU-1) was undertaken by the GROUP pursuant to an Administrative Order, dated September 28, 1990, and consisted of the following:

- a) A lateral containment wall comprising a soil-bentonite slurry wall with an integral high-density polyethylene (HDPE) vertical membrane, which circumscribes the property;
- b) A horizontal "infiltration barrier" consisting of high density polyethylene (HDPE) covering the property;
- c) A sheet pile retaining wall along Peach Island Creek;
- d) An extraction system for shallow groundwater consisting of five extraction wells screened in the fill, which discharge to an above grade 10,000 gallon holding tank via an above grade header system; and
- e) A chain link fence circumscribing the Site.

The OU-1 Remedy has been in operation since June 1992, and extracted groundwater is regularly shipped, via tanker trucks, to the DuPont Environmental Treatment (DET) facility, located in Deepwater, New Jersey, for treatment and disposal. Landscaping along the perimeter of the Site adjacent to Paterson Plank Road and Gotham Parkway was added following installation of the Interim Remedy.

On August 26, 2002, USEPA issued a ROD for Operable Unit No. 2 (OU-2), which identified the selected final remedy for the fill materials and shallow groundwater above the clay layer underlying the Site. Subsequently, a Consent Decree was lodged on July 14, 2004, with an effective date of September 30, 2004, which provides for implementation of the OU-2 final remedial action by the Group.

Per the August 26, 2002 ROD, the remedial action objectives for OU-2 are as follows:

- Mitigate direct contact risks and leaching of contaminants from the shallow fill and sludge material into groundwater;
- Reduce toxicity and mobility of the sludge “Hot Spot” contaminants via treatment;
- Provide hydraulic control of the shallow aquifer by maintaining inward groundwater gradients; and
- Perform remediation such that the final remedy may allow for possible, limited (i.e., light commercial) Site re-uses.

The specific remedy elements that were selected in the ROD to achieve these objectives were:

- Installing a cover system over the entire fill area circumscribed by the existing slurry wall;
- Undertaking stream bank enhancements to provide improved stability, while avoiding adverse impacts to the existing slurry wall and Peach Island Creek;
- Remediating the sludge “Hot Spot” area by in-situ treatment; and
- Upgrading, enhancing and replacing, as necessary, the existing groundwater recovery system to ensure inward groundwater gradients are maintained.

1.02 DESCRIPTION OF WORK

This Contract includes all personnel, supervision, services, labor, home, office, technical and administrative support, materials, tools, equipment and supplies for the following:

- A. Mobilization and demobilization, and the preparation of work plans required by these Technical Specifications;
- B. Preparation and implementation of a CONTRACTOR-developed, Site-specific Health and Safety Plan;
- C. All field engineering and temporary facilities, including design thereof, required to perform the Work;
- D. Preparation of a Site-specific Erosion and Sediment Control Plan and installation and maintenance of related devices as described in, or required by, the Contract Documents;
- E. Removal of an existing office trailer, and disposal of designated stockpiles of IDW waste materials, as defined by the Contract Drawings;
- F. Demolition of an on-site, existing building structure, and the off-site disposal of all debris resulting from said demolition;
- G. Construction of a new pre-fabricated building structure, which will contain storage, bathroom, and office areas. In addition, this structure would include the control systems and leachate storage tank, as specified as part of the proposed enhanced groundwater extraction system;
- H. Clearing and grubbing of the areas to receive an engineered cap, laydown and staging areas, and access roads;

- I. Systematic and sequential removal of the existing geomembrane liner materials, and off-site disposal of said liner materials;
- J. Completion of specified In-situ “Hot Spot” Treatment activities, including air stripping and In-situ Soil Stabilization (ISS) techniques;
- K. Installation of an enhanced groundwater extraction system, including new pumping wells, control systems, and an on-site Leachate collection tank;
- L. Installation of a series of piezometer pairs around the Site perimeter, and two interior piezometers, to monitor internal and external water levels within the underlying Fill stratum;
- M. Decommissioning of the existing groundwater extraction system, including removal of all existing pumping wells, piezometers and monitoring wells circumscribed by the perimeter soil-bentonite containment slurry wall, and removal of the existing on-site leachate storage tank;
- N. Dewatering, excavation, relocation, placement, regrading, and compaction of soil and waste to meet the subgrade grading plan;
- O. Placement of grading fill, as necessary, to meet the grades and Site modifications as shown on the Contract Drawings;
- P. Installation of a new steel sheet pile wall along Peach Island Creek. This wall will be located about five (5) feet behind the existing deteriorated steel sheet pile wall. In addition, the Work will include the removal of the existing steel sheet pile wall system and buttressing H-pile sections to the low water level of Peach Island Creek;
- Q. Construction of an engineered cap, which is comprised of a geosynthetic clay liner, a geomembrane, a geocomposite drainage layer, an 12-inch thick cover soil layer, and a 6-inch thick vegetative support layer;
- R. Construction of a surface water management system, including surface water perimeter channels and culverts;
- S. Re-vegetation of all disturbed areas, including the area to receive the engineered landfill cover, and adjacent areas regraded or disturbed during construction;
- T. Construction and maintenance of Site access roads around the Site perimeter, in support of post-construction operations and maintenance activities;
- U. Removal and replacement of perimeter security fence and gates, as shown on the Contract Drawings;
- V. All required Quality Assurance and Quality Control (QA/QC) testing services;
- W. All health and safety equipment/monitoring, as well as monitoring and control of nuisances such as noise, dust and odor for Site workers and the surrounding community;
- X. Provision of Site security during construction to control access to the work area and to protect the Work and the Contractor’s equipment and materials; and

Y. Preparation of progress reports, submittals, and Contract Record Documents.

All Work described above shall be performed in strict accordance with the Contract Documents, the CONTRACTOR's Health and Safety Plan, and the Consent Decree. Guidance on Site hazards that must, at a minimum, be addressed in the CONTRACTOR's Health and Safety Plan is required by Section 01564 of these Technical Specifications.

The Work shall be completed in accordance with the schedule provisions provided by the Contract Documents, time being of the essence with regard to all time specifications. CONTRACTOR shall provide and identify a "Competent Person" to implement, supervise and inspect all Work.

1.03 QUANTITIES

- A. The GROUP reserves the right to alter, increase or decrease the quantities of Work to be performed, at any time, when and as found necessary, and the CONTRACTOR shall perform the Work as altered, increased or decreased. Payment for such increased or decreased quantity will be made in accordance with the Contract. No allowance will be made for any change in anticipated profits nor shall such changes be considered as waiving or invalidating any conditions or provisions of the Contract.

1.04 NOISE LIMITS AND WORK PERIOD RESTRICTIONS

- A. Noise must be curtailed between 7:00 p.m. and 7:00 a.m., Monday through Saturday, inclusive. Activities outside of those hours may be undertaken only with the prior approval of the GROUP. No construction activities shall be performed on Sundays (7:00 p.m. Saturday through 7:00 a.m. Monday).

1.05 PRELIMINARY CONSTRUCTION SCHEDULE

- A. Each Bidder shall prepare and submit its anticipated Construction Schedule with its bid.
- B. CONTRACTOR shall prepare and submit to GROUP REPRESENTATIVE its anticipated schedule within five (5) days after receipt of its Notice to Proceed, identifying the sequence of activities and critical path activities and milestones affecting achievement of the schedule requirements specified in the Contract Documents.

1.06 STOCKPILE AND STAGING AREAS

- A. Possible areas for the CONTRACTOR's staging and stockpile area shall be proposed by the CONTRACTOR for approval by the QUALITY ASSURANCE OFFICER (QAO) or GROUP's REPRESENTATIVE.

1.07 REGULATORY REQUIREMENTS

- A. The CONTRACTOR shall conduct all Work of this Contract in accordance with all applicable local, State, and Federal laws, regulations, codes, permit equivalencies and ordinances.

- B. The CONTRACTOR shall complete all permit equivalency requirements, including submission of documentation as necessary for completion of the Work, including air permit equivalencies for the in-situ "Hot Spot" treatment..

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

- A. In case of conflicts between various parts of the Contract Documents, the REMEDIAL DESIGNER shall be notified to initiate resolution.
- B. "Related Sections" which are listed in the individual Specifications of the Contract Documents are not comprehensive and all inclusive. It is the CONTRACTOR's responsibility to become familiar with the Contract Documents and interrelationships. Any inconsistencies in the Contract Documents identified by the CONTRACTOR shall be brought to the GROUP's REPRESENTATIVE to resolve.

*****END OF SECTION*****

SECTION 01015

DEFINITIONS

PART 1 - GENERAL

1.01 PARTICIPANTS

- A. USEPA: The word "USEPA" means the US Environmental Protection Agency, Region II, 290 Broadway, New York, NY 10007-1866.
- B. NJDEP: The word "NJDEP" means the New Jersey Department of Environmental Protection, 401 East State Street, 5th Floor, CN 028 Trenton, NJ 08625.
- C. GROUP: The word "GROUP" means the 216 Paterson Plank Road Cooperating PRP Group.
- D. GROUP's REPRESENTATIVE: The words "GROUP's REPRESENTATIVE" or "GROUP's REPRESENTATIVES" mean a representative or representatives of the 216 Paterson Plank Road Cooperating PRP Group, as identified in the Contract Agreement.
- E. CONTRACTOR: The word "CONTRACTOR" means the individual, partnership, firm, corporation or any combination thereof, including SUBCONTRACTORS, contracting with the GROUP for work covered by these Specifications.
- F. REMEDIAL DESIGNER: The words "REMEDIAL DESIGNER" mean Golder Associates Inc., 200 Century Parkway, Suite C, Mt. laurel, New Jersey, 08054.
- G. QUALITY ASSURANCE OFFICIAL OR OFFICER (QAO): The words "QUALITY ASSURANCE OFFICER" or "QUALITY ASSURANCE OFFICE" are to be determined.
- H. SUBCONTRACTOR: The word "SUBCONTRACTOR" means the individual, partnership, firm, corporation or any combination thereof, contracting with the CONTRACTOR for work covered by these Specifications.
- I. MANUFACTURER: The word "MANUFACTURER" means the individual, partnership, firm, corporation or any combination thereof, which produces or supplies materials used to complete the Work.

1.02 CONTRACT DEFINITIONS

- A. Addenda: Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Documents or the Contract Documents.
- B. Application for Payment: The form accepted by the GROUP's REPRESENTATIVE which is to be used by the CONTRACTOR in requesting

progress or final payments, and which is to include such supporting documentation as required by the Contract Documents.

- C. Bidding Documents: Includes the Invitation to Bidders, Information to Bidders, Bid Form, Form of Contract, Specifications, Contract Drawings, and the "Contract Documents" (including all Addenda issued prior to receipt of Bids).
- D. Bid: A document submitted by an interested party in response to the GROUP's request for proposal which includes the proposed methods, schedule, and costs for the interested party to perform the Work.
- E. Bonds: Bid, performance and payment bonds, and other instruments of security.
- F. Change Order: A document required by the GROUP's REPRESENTATIVE, which is signed by the CONTRACTOR and the GROUP authorizing an addition, deletion or revision in the Work, and/or an adjustment in the Contract Price or the Contract Time, issued on or after the Effective Date of the Agreement.
- G. Competent Person: The words "Competent Person" mean an individual provided by the CONTRACTOR, and approved by GROUP or GROUP's REPRESENTATIVE, who is qualified and experienced to implement, supervise, and inspect the Work.
- H. Construction Drawings/Contract Drawings: The drawings issued for construction which show the character and scope of the Work to be performed, which have been prepared or approved by the REMEDIAL DESIGNER, and which are included in the Contract Documents.
- I. Contract Documents: The Contract Documents include Specifications, all Addenda, the Agreement, General and Supplemental Conditions, Bid, and Contract Drawings.
- J. Contract Price: The amount payable by the GROUP to the CONTRACTOR under the Contract Documents. Minor changes to the Contract Price (\$10,000 or less) may be approved by the GROUP's REPRESENTATIVE.
- K. Contract Time: The number of days or the time period stated in the Form of Agreement for completion of the Work. The GROUP's REPRESENTATIVE may approve minor changes to the Contract Time (14 days or less), as long as the total number of days beyond the contract does not exceed thirty (30) days. Major schedule changes; i.e. greater than fourteen (14) days for a single task and greater than thirty (30) days for all tasks, must be approved by the GROUP.
- L. Defective Work: Work that is unsatisfactory, faulty or deficient, or does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to the GROUP's REPRESENTATIVE's recommendation of final payment (unless responsibility for the protection thereof has been assumed by GROUP at Substantial Completion).
- M. Deficiency: An element of completed work which has been identified as Defective.
- N. Field Order: A written order issued by the REMEDIAL DESIGNER that orders minor changes in the Work but does not involve changes in the Contract Price

nor the Contract Time, and does not require approval by the GROUP's REPRESENTATIVE.

- O. Form of Agreement: A legal contract between the CONTRACTOR and the GROUP which includes, but is not limited to the Contract Price and Contract Time for the Work.
- P. General Specifications: Sections contained in Division 1 of the Specifications.
- Q. Install: Provide and install, unless otherwise noted.
- R. Installer: The word "Installer" means the individual, partnership, firm, corporation, or any combination thereof, contracting with the CONTRACTOR for work covered by these Specifications.
- S. Laws and Regulations/Laws or Regulations: Laws, rules, regulations, ordinances, codes, and/or orders of any governmental entity having jurisdiction over the Work. The State of New Jersey shall be the jurisdiction for any and all disputes.
- T. Notice of Award: The written notice by the GROUP to the apparent successful Bidder stating that, upon compliance by the apparent successful Bidder with the conditions precedent enumerated therein and, within the time specified, the GROUP will sign and deliver the Agreement.
- U. Notice to Proceed: A written notice given by the GROUP's REPRESENTATIVE to the CONTRACTOR fixing the date on which the Contract Time will commence to run, and on which the CONTRACTOR shall start to perform the CONTRACTOR's obligations under the Contract Documents.
- V. Products: The term "material" or "products" shall include products, equipment, assembly methods, manufacturer, brand, trade name, or other description. References to "equivalent," "approved equivalent," or similar terms mean that approval from the REMEDIAL DESIGNER is required. All materials shall be new and specifically purchased for the Work under this Contract, unless as otherwise accepted by the GROUP's REPRESENTATIVE or specified in the Contract Documents. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
- W. Provide or Provided: Means "furnish and install" to the satisfaction of the GROUP's REPRESENTATIVE.
- X. Quality Assurance (QA): Means measures taken by the GROUP's REPRESENTATIVE through the QAO to independently assess if the contractor is in compliance with the Contract Documents for the project.
- Y. Quality Control (QC): Means measures taken by the CONTRACTOR to determine compliance with the requirements for materials and workmanship as stated in the Contract Documents.
- Z. Record Documents: A complete set of Contract Documents marked such that any field changes are readily identified. These Record Documents shall be maintained by the CONTRACTOR on-Site, and upon Contract completion, shall be sealed and provided to the GROUP.

- AA. Referenced Standard: A recognized standard, which is identified in a Specification and incorporated by reference.
- AB. Schedule of Values: The CONTRACTOR's itemized listing of activities of the Work, set forth, in a form acceptable to the GROUP's REPRESENTATIVE, which describes the CONTRACTOR's allocation of the Contract Price by activity. These same activities shall be identical to those listed in the CONTRACTOR's progress schedule.
- AC. Shop Drawings: All drawings, diagrams, illustrations, schedules, and other data which are specifically prepared by or for the CONTRACTOR to illustrate some portion of the Work; and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams, and other information prepared by a Supplier, and submitted by the CONTRACTOR to illustrate material or equipment for some portion of the Work, and that must be maintained on-site.
- AD. Substantial Completion: The Work (or a specified part thereof) has progressed to the point where, in the opinion of the GROUP's REPRESENTATIVE as evidenced by the GROUP's definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that final payment is due. The terms "substantially complete" and "substantially completed" as applied to any Work refer to Substantial Completion thereof.
- AE. Successful Bidder: The Bidder to whom the GROUP makes an award.
- AF. Supplier: A manufacturer, fabricator, distributor, material man, or vendor.
- AG. Technical Specifications/Specifications: Those portions of the Bidding Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.
- AH. Transportation and Handling: All material shall be shipped, delivered, and stored in the manufacturer's undamaged crating and packaging, except as otherwise approved by the REMEDIAL DESIGNER. All materials shall be protected and stored off the ground on blocking, or pallets, and shall be covered as appropriate. All material shall be protected from damage due to weather, vandalism, etc.
- AI. Work: The entire completed construction, or the various separately identifiable parts thereof, required to be furnished under the Contract Documents. Work is the result of performing services, furnishing labor, and furnishing and incorporating materials and equipment into the construction, as required by the Contract Documents.

PART 2 - PRODUCTS

Not Used.

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PART 3 - EXECUTION

Not Used.

*****END OF SECTION*****

SECTION 01041

PROJECT COORDINATION

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. Management of the Project (Work) shall be through the use of a logical method of construction planning, inspection, scheduling, and cost value documentation.
- B. The Work under this Section includes all inspections and coordination by the CONTRACTOR necessary for the proper and complete performance of the Work.
- C. This Section applies to the Work of every Division and every Section of these Specifications.

1.02 SITE CONDITIONS

- A. Inspection
 - 1. Prior to performing any Work under a Section, the CONTRACTOR shall carefully inspect the installed Work of other trades, and shall verify that all such Work is complete to the point where the Work under that Section may properly commence.
 - 2. The CONTRACTOR shall verify that all materials, equipment, and products to be installed under a Section will be installed in accordance with the Contract Documents and pertinent reviewed Shop Drawings.
- B. Discrepancies
 - 1. In the event of a discrepancy, immediately notify the GROUP's REPRESENTATIVE and QUALITY ASSURANCE OFFICER (QAO).
 - 2. Do not proceed with installation in areas of discrepancy until all related discrepancies have been fully resolved.
- C. Mobilization
 - 1. Cooperate with the GROUP's REPRESENTATIVE and/or QAO in allocation of mobilization areas, field offices, sheds, access, traffic, and parking facilities.
 - 2. During construction, coordinate use of Site and facilities through the GROUP's REPRESENTATIVE and/or QAO.
 - 3. Comply with the Contract Documents, and coordinate with the QAO for intra-project communications, submittals, reports and records, schedules, coordination, drawings, and resolution of ambiguities and conflicts.
 - 4. Comply with the instructions of the GROUP's REPRESENTATIVE and/or QAO for use of temporary utilities and construction facilities.

5. The CONTRACTOR shall provide field engineering, including surveying, and layout in accordance with Section 01050, and shall coordinate such activities with the QAO.

1.03 COORDINATION WITH OTHERS

- A. Carefully coordinate Work with all other trades and SUBCONTRACTORS to ensure proper and adequate interface of the Work of other trades and subcontractors with the Work of every Section of these Specifications.
- B. The CONTRACTOR shall coordinate operations with all utility companies in or adjacent to the area of CONTRACTOR's Work. The CONTRACTOR shall require said utilities to identify in the field their property and provide drawings as necessary to locate them.
- C. The CONTRACTOR shall coordinate Work with Community representatives and GROUP REPRESENTATIVE to ensure minimal disturbance to operations and traffic flow outside of the Site limits.
- D. The CONTRACTOR shall coordinate Work with requirements for quality control or quality assurance testing by the REMEDIAL DESIGNER. The CONTRACTOR shall provide access to Work for inspection and shall stop portions of Work as necessary to allow for inspection.
- E. The CONTRACTOR shall coordinate Work with any requirements of Trade Unions having jurisdiction in the Site area.

1.04 MEETINGS

- A. The CONTRACTOR shall attend a pre-construction meeting with the GROUP's REPRESENTATIVE and REMEDIAL DESIGNER to review project schedule and status of submittals;
- B. The CONTRACTOR shall meet with local authorities to coordinate traffic controls and restrictions required for transportation of materials to the Site for the Work from off-site sources/suppliers.
- C. The CONTRACTOR's Superintendent shall participate in weekly on-site construction progress meetings to be lead by the GROUP REPRESENTATIVE. Weekly meetings will include, but not be limited to: work progress vs. schedule; resolution of any identified change order requests where allowed by the Contract Documents, and non-compliances with the Contract Documents.

1.05 SCHEDULES

- A. The CONTRACTOR shall submit the initial Construction Schedule to the GROUP's REPRESENTATIVE and REMEDIAL DESIGNER for review in accordance with Section 01300 of these Specifications. After review, the CONTRACTOR shall revise and resubmit, if necessary, the Construction

Schedule to the GROUP's REPRESENTATIVE and REMEDIAL DESIGNER for approval.

- B. During the progress of the Work, the CONTRACTOR shall revise and resubmit the Construction Schedule as requested by the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, and/or QAO and in any case, at least monthly. Submit a revised Construction Schedule with each Application for Payment.
- C. The CONTRACTOR shall prepare all schedules using Microsoft Project, or equivalent software program, as favorably reviewed by the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, and QAO. The CONTRACTOR's schedule shall be resource (labor and equipment) loaded, show critical path, start and end dates, and float time of various stages of the work. Copies shall be provided in hard copy and electronically (i.e., via e-mail and/or computer file), as requested by the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, and/or QAO.

1.06 OTHER COORDINATION

- A. CONTRACTOR shall submit requests for clarification of the Contract Documents through the REMEDIAL DESIGNER. The REMEDIAL DESIGNER may provide further coordination with the QAO.
- B. Process requests for Change Orders through the GROUP's REPRESENTATIVE, in accordance with Section 00700 of these Technical Specifications.
- C. Deliver closeout submittals for review, and preliminary inspection reports for transmittal, to the GROUP's REPRESENTATIVE.
- D. Notify the GROUP's REPRESENTATIVE when the Work is considered substantially complete, in accordance with Section 00700 of these Specifications. Accompany the GROUP's REPRESENTATIVE and QAO on a preliminary final inspection.
- E. Comply with the instructions of the GROUP's REPRESENTATIVE for completion of any items of the Work determined not to be substantially complete by the preliminary final inspection.
- F. Provide Record Documents in accordance with Section 01720 of these Specifications.

PART 2 - PRODUCTS

Not Used.

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PART 3 - EXECUTION

Not Used.

*****END OF SECTION*****

SECTION 01050

FIELD ENGINEERING AND SURVEYING

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. Work under this Section includes all surveying necessary for accurate location of all features of construction, establishing all proposed grades, documenting as-built conditions, reporting of data in hard copy, and Professional Land Surveyor (PLS) certification. The CONTRACTOR shall be responsible for all surveys and calculations for layout of Work, verification of proper grading and field fits to existing conditions and grades, layer thickness, quantities needed for payment of unit price bid items, and preparation of project record (as-built) drawings. The CONTRACTOR shall not rely upon the existing topographic contours as pre-construction documentation. Any pre-construction documentation needed by the CONTRACTOR to properly perform the Work, shall be provided by the CONTRACTOR at the CONTRACTOR's expense.
- B. All surveying personnel who may come in contact with refuse and/or may work within excavations must have, at a minimum, training in accordance with 29 CFR 1910.120.

1.02 SUBMITTALS

- A. CONTRACTOR shall submit for approval the name, address, and telephone number of the Surveyor to the GROUP's REPRESENTATIVE prior to initiation of survey work. The CONTRACTOR's surveyor shall be qualified, have previous experience in this type of construction, and shall be a Professional Land Surveyor licensed and registered in the State of New Jersey. The surveyor shall also have a minimum of five (5) years experience in construction surveying layout and maintenance of construction Record Drawings with a successful record of performing horizontal and vertical control requirements as stated in the Contract.
- B. The CONTRACTOR shall submit documentation verifying the accuracy of the survey and Work to the GROUP's REPRESENTATIVE on request.
- C. Record Drawings and survey notes sealed and signed by Surveyor stating that elevations and locations of constructed features are in conformance with the Contract Documents shall be submitted to the GROUP's REPRESENTATIVE. This documentation will be required upon completion of any unit price bid item and any additional work authorized by the GROUP's REPRESENTATIVE.
- D. No Work shall be covered until the record survey has been performed, and the lines and grades are determined to meet the requirements of the Contract Drawings and Specifications. If the Work has been covered before surveying has taken place, this portion of the Work shall be uncovered, surveyed, and recovered at the

CONTRACTOR's expense. Any damages to Work that occur as a result of uncovering the material for survey shall be at the CONTRACTOR's expense.

- E. Upon completion of the Work, a complete set of Record Documents for all construction work must be submitted by the CONTRACTOR to the GROUP's REPRESENTATIVE for review and acceptance under the provisions of Section 01720. Copies of all required survey data, calculations, and summary tables shall be submitted, as requested, signed and sealed by a Professional Land Surveyor licensed and registered in the State of New Jersey. If insufficient detail is provided to document proper completion of the Work as determined by the GROUP's REPRESENTATIVE or the QUALITY ASSURANCE OFFICER (QAO), the CONTRACTOR shall provide additional record survey information at no additional cost to the GROUP.

1.03 SURVEY REQUIREMENTS

- A. Provide field engineering services. Use generally recognized and accepted engineering and land surveying practices.
- B. Establish elevations, lines, and levels. Locate and layout by instrumentation and similar appropriate means:
1. Existing underground pipes and/or structures to be modified or connected to; or, located in such manner as to affect any portion of the Work. Include depths to pipe to assist with the progression of excavation.
 2. Line and grade for measurement and payment purposes (i.e., determination of in-place quantities). The CONTRACTOR shall provide sufficient survey to verify the quantities included in Applications for Payment.
 3. Record survey information shall include, but not be limited to, the following:
 - a. Alignment and profile of all underground features;
 - b. Limits of cap placement;
 - c. Location of all fences and gates;
 - d. Pre-construction survey of entire Site prior to excavation and fill placement for subgrade regrading;
 - e. Completed subgrade following landfill regrading;
 - f. Top of grading layer;
 - g. Limits of the geosynthetic clay liner;
 - h. Limits of the geomembrane cap, including panel alignment and designations, and seam locations and intersections;
 - i. Locations for geomembrane destructive test locations, labeled with QAO's designations;
 - j. Locations of all repairs labeled with QAO's designations;
 - k. Limits of the geocomposite drainage layer;
 - l. Top of cover soil;
 - m. Top of vegetative support layer;
 - n. Locations and elevations of the access roads;

- o. The finished grade elevations at a contour interval of 1 foot to a tolerance of ± 0.1 foot;
- p. Limits of all perimeter and surface water channels and riprap, including cross sections (crests and toes of slope) at 50-foot intervals and at grade breaks along all channels;
- q. Invert elevations at the inlets and outlets of all pipes and culverts and at intermediate locations at 50-foot intervals along the pipe;
- r. Locations of all installed pumping wells and piezometers;
- s. Limits and locations of installed steel sheet pile walls;
- t. Limits of the In-situ "Hot Spot" Treatment area;
- u. Location of constructed pre-fabricated structures;
- v. Other visible features in the construction area; and
- w. Any additional requirements of Sections 01025 and 01720 of these Technical Specifications.

C. Verify layouts by same means prior to backfilling.

1.04 SURVEYS FOR MEASUREMENT FOR PAYMENT

- A. The CONTRACTOR shall perform surveys, where required, to determine the quantities of Work performed/conducted, including control surveys to establish appropriate surveying references. Notify the REMEDIAL DESIGNER at every progress meeting of the planned survey activities during the upcoming period.
 - 1. At a minimum, surveys shall be performed prior to and following the completion of regrading, but prior to backfilling. The CONTRACTOR may also perform interim surveys to support Applications for Payment.
 - 2. Perform surveys to locate all pumping wells and piezometers. The locations shall be tied into the existing Site coordinate system to an accuracy of 0.01 feet. Elevations shall be surveyed to an accuracy of 0.01 feet.
 - 3. The CONTRACTOR will sign the Surveyor's field notes, or keep independent field notes, and shall calculate and certify quantities for payment purposes.
 - 4. Copies of all original survey data, calculations, and summary tables shall be submitted with all Applications for Payment and with the Project Record Documents.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

3.01 INSPECTION

- A. All surveys for this Contract must use, and be referenced to, the Site's existing coordinate system (Northing, Easting, and elevation), as indicated on the Contract Drawings.

- B. Survey control points providing horizontal and vertical control in the vicinity of the Site are available from the GROUP.
- C. The CONTRACTOR shall verify locations of Site reference and survey control points prior to starting Work. The GROUP's REPRESENTATIVE must be promptly notified of any discrepancies discovered by the CONTRACTOR.
- D. The CONTRACTOR should not rely on the topographic contours shown on the Contract Drawings for preparing record drawings or tie-in of Work to existing grades.

3.02 SURVEY REFERENCE POINTS

- A. The CONTRACTOR shall establish Site control points, which are tied to the vertical and horizontal references for the Site. The CONTRACTOR shall take measures to protect Site reference and survey control points prior to starting the Work, and must preserve permanent reference points throughout construction. Site reference and survey control points may not be relocated without prior written notice by the GROUP's REPRESENTATIVE.
- B. The GROUP's REPRESENTATIVE shall be immediately notified of loss, damage or destruction of any reference point, or relocation required because of changes in grades or other reasons. The CONTRACTOR shall replace disturbed survey control points based on original survey control at the CONTRACTOR's own expense.
- C. All horizontal and vertical control coordinates (i.e., Northings, Eastings, and elevations) of benchmarks and survey control points shall be determined (and recorded) with a maximum permissible error of ± 0.01 foot in any horizontal coordinate, and ± 0.01 foot in any vertical coordinate.
- D. The CONTRACTOR shall survey and clearly mark the limits of all Work areas.

3.03 SURVEY REQUIREMENTS

- A. The CONTRACTOR shall reference all survey and data reference points to permanent benchmarks and record the locations of survey control points, with horizontal and vertical data, on the Project Record Documents.
- B. The CONTRACTOR shall verify layouts periodically during construction by the same means as the original layout.
- C. Pre-construction surveys shall be performed in the construction area to establish baseline grade elevations on a 50-foot grid, at all slope breaks along the limits of construction. Each successive layer shall be surveyed on this same grid. Surveys shall be performed prior to the staging of materials or equipment, and grade stakes shall be used to control excavating and filling. No payment will be made for the excavation of materials placed on-site by the CONTRACTOR.

- D. Construction surveys shall be performed on the same 50-foot grid, at all slope breaks, at the edges of construction, and along all of the channels, swales, roads, and berms. Additionally, the inverts of all culverts at the inlet and outlet shall also be surveyed.

*****END OF SECTION*****

SECTION 01200

PROJECT MEETINGS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The Work under this Section includes all scheduling and administering of Pre-Construction, In-situ “Hot Spot” Treatment and Geosynthetic Kick-off Meetings, Progress Meetings, and Application for Payment Meetings, as specified herein, as necessary, for the proper and complete performance of the Work.
- B. Scheduling and administration by the GROUP’s REPRESENTATIVE, or QUALITY ASSURANCE OFFICER (QAO), shall include the following:
 - 1. Prepare an agenda for each meeting;
 - 2. Make time arrangements for the meetings;
 - 3. Preside at the meetings;
 - 4. Record minutes, and include significant proceedings and decisions; and,
 - 5. Distribute copies of the minutes to participants within five (5) working days after each meeting.
- C. The CONTRACTOR shall make physical arrangements for meetings. Representatives of the CONTRACTOR, subcontractors, installers, and suppliers attending the meetings shall be qualified and authorized to act on behalf of the entity each represents. The GROUP’s REPRESENTATIVE and/or QAO will confirm that the Work is expedited consistent with the Contract Documents and the Construction Schedule.

1.02 PRE-CONSTRUCTION MEETING

- A. The GROUP’s REPRESENTATIVE, REMEDIAL DESIGNER, or QAO shall schedule the Pre-construction meeting following issuance of the Notice to Proceed.
- B. Representatives of the following parties shall be in attendance at the meeting:
 - 1. GROUP’s REPRESENTATIVE, if appropriate;
 - 2. CONTRACTOR and Superintendent;
 - 3. Major SUBCONTRACTORS;
 - 4. Representatives of governmental or regulatory agencies, as appropriate;
 - 5. REMEDIAL DESIGNER; and,
 - 6. QAO.
- C. The agenda for the Pre-construction meeting shall include, at a minimum, the following:

1. Distribute and discuss a list of major subcontractors/suppliers and a tentative Construction Schedule;
2. Identification of critical path work sequencing;
3. Designation of responsible personnel and emergency telephone numbers;
4. Processing of Field Orders and Change Orders;
5. Schedule for submission of Shop Drawings, product data and samples;
6. Format for Application for Payment, submittal cutoff date, paydate and retainage;
7. Procedures for maintaining Record Documents;
8. Use of premises and the requirements of the GROUP's REPRESENTATIVE, and regulatory agencies;
9. Major equipment deliveries and priorities;
10. Site-specific Health and Safety Plan requirements;
11. Site-Specific Soil Erosion and Sedimentation Control requirements;
12. Security procedures;
13. Access provisions for adjacent properties;
14. Housekeeping procedures; and,
15. Work hours.

1.03 IN-SITU "HOT SPOT" TREATMENT KICK-OFF MEETING

- A. CONTRACTOR shall schedule a In-situ "Hot Spot" Treatment kick-off meeting at the Site in offices provided by the CONTRACTOR, prior to mobilization of the In-situ Soil Treatment subcontractor.
- B. Representatives of the following parties are to be in attendance at the In-situ "Hot Spot" Treatment kick-off meeting:
 1. GROUP's REPRESENTATIVE;
 2. CONTRACTOR's Superintendent;
 3. In-situ Soil Treatment subcontractor;
 4. Surveyor;
 5. REMEDIAL DESIGNER;
 6. QAO; and
 7. Representatives of governmental or other regulatory agencies, as appropriate.
- C. The minimum agenda for the In-Situ "Hot Spot" Treatment kick-off meeting:
 1. In-situ Soil Treatment methods and procedures;
 2. Review of performance criteria and field verification project requirements;
 3. QA/QC procedures and minimum testing frequency;
 4. Survey requirements;
 5. QA/QC testing turnaround times;
 6. On-site QC testing capabilities; and
 7. QA re-testing (due to failure of samples) paid by CONTRACTOR.

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1.04 GEOSYNTHETICS KICK-OFF MEETING

- A. CONTRACTOR shall schedule a geosynthetics kick-off meeting at the Site in offices provided by the CONTRACTOR, prior to mobilization of the geosynthetic installation subcontractor.
- B. Representatives of the following parties are to be in attendance at the geosynthetics kick-off meeting:
 - 1. GROUP's REPRESENTATIVE;
 - 2. CONTRACTOR's Superintendent;
 - 3. Geosynthetics Manufacturer;
 - 4. Geosynthetics Installer;
 - 5. Surveyor;
 - 6. REMEDIAL DESIGNER;
 - 7. QAO; and,
 - 8. Representatives of governmental or other regulatory agencies, as appropriate.
- C. The minimum agenda for the geosynthetics kick-off meeting:
 - 1. Materials to be used, as favorably reviewed by REMEDIAL DESIGNER;
 - 2. QA/QC procedures and minimum testing frequency;
 - 3. Survey requirements;
 - 4. Anticipated material delivery dates for each material;
 - 5. Anticipated installation dates for each material;
 - 6. QA/QC testing turnaround times;
 - 7. On-site QC testing capabilities; and,
 - 8. QA re-testing (due to failure of samples) paid by CONTRACTOR.

1.05 PROGRESS MEETINGS

- A. The GROUP's REPRESENTATIVE or QAO shall schedule regular weekly (or other appropriate frequency) meetings to be held on-Site.
- B. Hold meetings as the progress of the Work dictates.
- C. The meetings shall be held at the Site in offices provided by the CONTRACTOR.
- D. Representatives of the following parties are to be in attendance at the progress meetings:
 - 1. GROUP's REPRESENTATIVE;
 - 2. CONTRACTOR and Superintendent;
 - 3. Major subcontractors as pertinent to the agenda;
 - 4. REMEDIAL DESIGNER, as necessary;
 - 5. QAO; and,

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6. Representatives of governmental or other regulatory agencies, as appropriate.

E. The minimum agenda for Progress Meetings shall include the following:

1. Review and approve minutes of previous meetings;
2. Review Work progress since last meeting;
3. Discuss field observations, problems, and decisions;
4. Review proposed changes for their effect on the Construction Schedule and completion date;
5. Review off-Site fabrication problems and product delivery schedule;
6. Review the CONTRACTOR's measures and procedures for correction of defective work, if applicable;
7. Review submittal schedule; expedite as required to maintain Construction Schedule;
8. Review QA/QC test results;
9. Status of record survey documentation;
10. Review with the QAO the anticipated days during the upcoming work period that the Contractor's surveyor will be on-site;
11. Maintenance of quality and work standards; and
12. Review construction safety issues.

1.06 APPLICATION FOR PAYMENT MEETINGS

- A. Schedule meeting for Applications for Payment as required by the Contract Documents, or as requested.
- B. Representatives of the following parties are to be in attendance at the meetings:
 1. GROUP's REPRESENTATIVE;
 2. CONTRACTOR;
 3. QAO, as appropriate; and,
 4. Subcontractors, as appropriate.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

*****END OF SECTION*****

SECTION 01300

SUBMITTALS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. Submittals required hereunder and elsewhere in the Contract Documents, shall be submitted by the CONTRACTOR to the REMEDIAL DESIGNER.
- B. Prior to mobilization to the Site and within fifteen (15) business days after the date of commencement, as stated in the Notice to Proceed (except where noted otherwise in these Specifications), the CONTRACTOR shall submit to the REMEDIAL DESIGNER:
 - 1. Detailed construction work plan including how the CONTRACTOR intends to proceed with the Work through completion. In addition, this plan shall include details with respect to how the CONTRACTOR intends to comply with the Quality Assurance and Quality Control (QA/QC) requirements, as defined by these Technical Specifications;
 - 2. Detailed Site-specific Health and Safety Plan developed in accordance with all applicable laws and regulations, OSHA 29 CFR 1910 and 1926, and Section 01564 of these Specifications.
 - 3. Construction Schedule that indicates the starting and completion dates of the various stages of the Work, resource (labor and equipment) loading, float time, and critical path analysis using Microsoft Project, or equivalent software program as favorably reviewed by the GROUP's REPRESENTATIVE.
 - 4. A preliminary schedule of submittals. The schedule should include Shop Drawing, sample, and proposed substitute or "or equivalent" submittals. The CONTRACTOR shall thoroughly read each section of the Specifications, carefully review the Contract Drawings, and reference the appropriate section of the Specifications for each submittal. Submittals comprising the schedule shall indicate revision number and date.
 - 5. List of potential applicable permits and approvals, which may be required to perform the Work.
 - 6. Erosion and Sedimentation Control Plan in accordance with Section 02125 of these Specifications.
 - 7. Site Access and Traffic Control Plan in accordance with Section 01550 of these Specifications.
 - 8. Site Security Plan in accordance with Section 01540 of the Specifications.
 - 9. Excavation Support Plan in accordance with Section 02150 of the Specifications.
 - 10. Soil and Waste Plan in accordance with Section 02221 of these Specifications.

11. Qualifications of all subcontractors and Materials Testing Laboratories.
 12. Qualifications of the CONTRACTOR, including its Project Manager and Superintendent, and all major subcontractors, in accordance with the requirements of the Consent Decree, for submittal to USEPA.
 13. A separate listing of the substitutions the CONTRACTOR proposes.
- C. Any details deemed by the CONTRACTOR to be required for the Work, but not indicated in the Contract Documents, shall be submitted by the CONTRACTOR for review by the REMEDIAL DESIGNER at least twenty (20) business days prior to the construction of that portion of the Work. Identifying any such details is the responsibility of the CONTRACTOR.
- D. All submittals must be provided to the REMEDIAL DESIGNER for favorable review within ninety (90) calendar days of the Notice to Proceed.

1.02 SUBMITTAL PROCEDURES

- A. Furnish at least five (5) copies for each Submittal. The REMEDIAL DESIGNER will retain four copies, and return one (1) copy of the submittal to the CONTRACTOR. If the CONTRACTOR wishes to receive more than one (1) copy of the reviewed submittal, submit additional copies beyond the minimum five (5) copies, up to a maximum of eight (8) copies.
- B. Submittals, as used herein, shall be understood to include detailed signed calculations; fabrication, installation, and erection drawings; lists; graphs; operating instructions; catalog sheets; data sheets; information from manufacturer or fabricator; and all other similar items.
- C. All Shop Drawing submittals shall be accompanied by a submittal transmittal form acceptable to the REMEDIAL DESIGNER. Any submittal not accompanied by such a form, or where all applicable items on the form are not completed, will be returned to the CONTRACTOR without review.
- D. The GROUP may elect to establish a secure, password-protected, project web page for the project. If this web page is established, the CONTRACTOR's submittals shall be provided to the REMEDIAL DESIGNER in electronic (.pdf) format, in addition to the paper copies required by Article 1.02.A.
- E. For submittals listed in the Consent Decree, the CONTRACTOR will provide additional copies for submittal to the USEPA and NJDEP after these submittals have been favorably reviewed by the REMEDIAL DESIGNER.

1.03 GENERAL REQUIREMENTS FOR SUBMITTALS

- A. A separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will be permitted only when the items taken together constitute a manufacturer's "package" or are so

functionally related that expediency indicates review of the group or package as a whole. A multiple-page submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to the REMEDIAL DESIGNER.

- B. Submittals must be clearly legible. When only a particular portion of a standard-issue material, such as a manufacturer's catalog or data sheet, is relevant to a submittal, the relevant portion(s) must be clearly indicated on all copies and all non-relevant portion(s) must be struck through on all copies.
- C. Except as may otherwise be provided herein, the REMEDIAL DESIGNER will return each submittal to the CONTRACTOR with its comments noted thereon, within twenty (20) business days following their receipt by the REMEDIAL DESIGNER. One (1) copy will be returned to the CONTRACTOR, plus any extra copies submitted by the CONTRACTOR, as described in Article 1.02A above. It is considered reasonable that the CONTRACTOR shall make a complete and acceptable submittal to the REMEDIAL DESIGNER by either the first or second submission of a submittal item. The GROUP reserves the right to withhold monies otherwise due the CONTRACTOR to cover additional costs of the review beyond the second submittal. Any consequences or delays due to unacceptable submittals will not be cause for extensions in schedule or additional cost to the GROUP.
- D. If the submittal is returned to the CONTRACTOR marked "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will not be required.
- E. If the submittal is returned to the CONTRACTOR marked "MAKE CORRECTIONS NOTED," formal revision and resubmission of the submittal will not be required. Record Documents must reflect corrections.
- F. If the submittal is returned to the CONTRACTOR marked "AMEND-RESUBMIT," the CONTRACTOR shall revise the submittal and/or provide additional information as requested, and resubmit the required number of copies of the revised submittal to the REMEDIAL DESIGNER.
- G. If the submittal is returned to the CONTRACTOR marked "REJECTED-RESUBMIT," the CONTRACTOR shall revise the submittal and resubmit the required number of copies of the revised submittal to the REMEDIAL DESIGNER.
- H. Fabrication of an item may begin only after the REMEDIAL DESIGNER has favorably reviewed the pertinent submittals, and returned the applicable submittals to the CONTRACTOR marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents, and shall not be taken as the basis of claims for extra work, additional payment, or delays. Payment for fabricated items will not be made

prior to favorable review of associated submittals by the REMEDIAL DESIGNER.

- I. All CONTRACTOR submittals shall be carefully reviewed by an authorized representative of the CONTRACTOR, prior to submission to the REMEDIAL DESIGNER. Each submittal form shall be dated, signed, and certified by the CONTRACTOR, as being correct and in conformance with the Contract Documents, unless indicated otherwise. In the case of Shop Drawings, each copy shall be so dated, signed, and certified. The REMEDIAL DESIGNER will not review any CONTRACTOR submittals, which have not been so certified by the CONTRACTOR, or are incomplete, or not well-organized or indexed. All non-certified, incomplete, or unorganized submittals will be returned to the CONTRACTOR without action taken by the REMEDIAL DESIGNER, and any delays caused thereby shall be the total responsibility of the CONTRACTOR.
- J. The REMEDIAL DESIGNER's favorable review of CONTRACTOR's Shop Drawing submittals shall not relieve the CONTRACTOR of the entire responsibility for the correctness of details and dimensions, and for the overall adequacy of the submitted design, product, method, process, or appurtenance. The CONTRACTOR shall assume all responsibility and risk for any misfits due to any errors in the CONTRACTOR's submittals. The CONTRACTOR shall be responsible for the dimensions and the design of adequate connections and details, and for provision of all items and appurtenances necessary for complete and satisfactory Work.

1.04 CONTRACTOR'S PROGRESS SCHEDULE SUBMITTALS

- A. All Construction Schedule submittals by the CONTRACTOR shall include paper plots and electronic files, for use in schedule analysis by the GROUP'S REPRESENTATIVE, REMEDIAL DESIGNER and/or QUALITY ASSURANCE OFFICER (QAO).
- B. The CONTRACTOR shall revise the Construction Schedule, as required, and resubmit the schedule with each Application for Payment. Any Application for Payment submitted without an up-to-date Construction Schedule will not be processed.
- C. The CONTRACTOR shall show the complete sequence of construction by activity, identifying the Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, critical path, and duration.
- D. The CONTRACTOR shall indicate the estimated percentage of completion for each activity with each Application for Payment.
- E. The CONTRACTOR shall indicate the submittal dates required for Shop Drawings, product data, samples, and product delivery dates, including those furnished by the GROUP, if any.

1.05 PROPOSED SUBSTITUTES OF “OR EQUIVALENT” ITEMS

- A. Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item, or the name of a particular supplier, the naming of the item is intended to establish the type, function, and quality required. If the words “or equal” or “or equivalent” are not present, no substitutes will be allowed, whether or not such disallowance is specifically stated. If the name is followed by the words “or equal” or “or equivalent” indicating that consideration of a substitution is permitted, materials or equipment of other suppliers may be accepted by the REMEDIAL DESIGNER if sufficient information is submitted by the CONTRACTOR to allow the REMEDIAL DESIGNER to determine that the material or equipment proposed is equivalent, or equal to, that named, subject to the following requirements:
1. The burden of proof as to the type, function, and quality of any such substitute material or equipment shall be upon the CONTRACTOR.
 2. The REMEDIAL DESIGNER will be the sole judge as to the appropriateness and type, function, and quality of any such substitute material or equipment and the REMEDIAL DESIGNER’s decision shall be final.
 3. The REMEDIAL DESIGNER may require the CONTRACTOR to furnish, at the CONTRACTOR’s expense, additional data about the proposed substitute.
 4. GROUP’s REPRESENTATIVE may determine that proposed substitute requires approval of the USEPA or NJDEP, or other regulatory agency. Any delay resulting from the regulating agency’s review and approval or failure to approve the proposed substitute shall not be the basis for CONTRACTOR claim for additional compensation and/or time.
 5. The GROUP’s REPRESENTATIVE may require the CONTRACTOR to furnish, at the CONTRACTOR’s expense, a special performance guarantee, or other surety, with respect to any substitution.
 6. Acceptance by the GROUP’s REPRESENTATIVE and/or REMEDIAL DESIGNER of a substitute item proposed by the CONTRACTOR shall not relieve the CONTRACTOR of the responsibility for full compliance with the Contract Documents, and for adequacy of the substitute item.
 7. The CONTRACTOR shall be responsible for any resultant changes and all additional costs which the accepted substitution requires in the CONTRACTOR’s work, the work of its subcontractors and of others, and shall effect such changes at the CONTRACTOR’s expense. Such changes include, but are not limited to, changes in dimensions, locations, piping, fittings, clearances, electrical connections, sizing of equipment and appurtenant items, controls, alarms, and instrumentation.
 8. All proposed substitutions shall be listed at the time of bidding and in the schedule of submittals as required by Article 1.01-B(3).
- B. The procedure for review by the REMEDIAL DESIGNER shall consist of the following:

1. If the CONTRACTOR wishes to furnish or use a substitute item of material or equipment, the CONTRACTOR shall make written application to the REMEDIAL DESIGNER.
 2. Unless otherwise provided by law or authorized in writing by the GROUP's REPRESENTATIVE or REMEDIAL DESIGNER, the substitution request shall be submitted with the Bid Proposal and again within the twenty (20) business day period after receiving Notice to Proceed.
 3. Wherever a proposed substitute material or equipment has not been submitted within said period, or wherever the submission of a proposed substitute material or equipment has been judged to be unacceptable by the REMEDIAL DESIGNER, the CONTRACTOR shall provide the material or equipment specified in the Contract Documents.
 4. The CONTRACTOR shall certify that the proposed substitute will adequately perform the functions and achieve the results intended by the general design, be similar and of equal substance to that specified, and be suited to the same use as that specified.
 5. The REMEDIAL DESIGNER shall be allowed a reasonable time within which to evaluate each proposed substitute, which can be longer than the time period set forth in Article 1.03-C herein above, without providing any basis for an extension of time or additional costs. In any event, the REMEDIAL DESIGNER will endeavor to complete his review in no more than thirty (30) calendar days from receipt of submittal.
 6. As applicable, no Shop Drawing submittals will be made for a substitute item nor shall any substitute item be ordered, installed, or utilized without the REMEDIAL DESIGNER's prior written favorable review of the CONTRACTOR's substitution request.
 7. The REMEDIAL DESIGNER will record the time and expenses required by the REMEDIAL DESIGNER to evaluate substitutions proposed by the CONTRACTOR and to make changes in the Contract Documents occasioned thereby. Whether or not the REMEDIAL DESIGNER favorably reviews a proposed substitute, the CONTRACTOR shall, if requested, reimburse the GROUP for the charges of the REMEDIAL DESIGNER for evaluating each proposed substitute, except to the extent that there is a net savings in cost to the GROUP following adoption of the substitution.
- C. The CONTRACTOR's application for a proposed substitute shall contain the following statements and/or information that will be considered by the REMEDIAL DESIGNER in evaluating the proposed substitution:
1. The evaluation and acceptance of the proposed substitute will not prejudice the CONTRACTOR's achievement of substantial completion on time.
 2. Whether acceptance of the substitution for use in the Work will require a change in any of the Contract Documents to adapt the design to the proposed substitute.
 3. Whether incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty.

4. All variations of the proposed substitute from that specified shall be identified.
5. Available maintenance, repair, and replacement service shall be indicated.
6. Itemized list of all costs that will result directly or indirectly from acceptance of such substitute, including cost of redesign and claims of other contractors affected by the resulting change.

- D. Any tests performed by the REMEDIAL DESIGNER or the QAO to verify acceptability of substitutes shall be at the CONTRACTOR's sole expense.

1.06 SAMPLES SUBMITTAL

- A. As specifically required by the Contract Documents, the CONTRACTOR shall submit, at his expense, three (3) sets of samples (unless specified otherwise) of each such item or material to the REMEDIAL DESIGNER.
- B. Samples, as required herein, shall be submitted for acceptance a minimum of thirty (30) calendar days prior to ordering such material, and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delays in the Work.
- C. All samples shall be individually, legibly, and indelibly labeled or tagged, indicating thereon all specified physical characteristics and Supplier's name. Upon receiving acceptance of the REMEDIAL DESIGNER, one (1) set of the samples will be stamped and dated by the REMEDIAL DESIGNER and returned to the CONTRACTOR and the remaining two (2) sets will be retained by the REMEDIAL DESIGNER with one (1) set retained at the Site until completion of the Work.
- D. Unless otherwise specified, all colors and textures of specified items will be selected by the GROUP'S REPRESENTATIVE from the manufacturer's standard colors and standard materials, products, or equipment lines.

1.07 RECORD DOCUMENTS SUBMITTAL

- A. The CONTRACTOR shall keep and maintain at the Site, one (1) set of Record Documents, per Section 01720 of these Technical Specifications. The Record Documents shall document conditions encountered during construction that differ from those shown on the Contract Documents and as-constructed locations of elements of the project, as determined by survey. The CONTRACTOR shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented in the Contract Documents, including buried or concealed construction and utility features which are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or that were not indicated in the Contract Documents. Record Documents shall be supplemented by detailed sketches, as

necessary or directed to fully indicate the Work as actually constructed. Include all survey data obtained from excavations to expose existing buried piping. The Record Documents are the CONTRACTOR's representation of as-constructed conditions, including all revisions made necessary by Addenda, Change Orders, and the like, and shall be maintained up-to-date during the progress of the Work. One copy of relevant Record Documents shall be submitted to the QAO with each Application for Payment. Record Documents shall conform to the requirements of Section 01720 of these Technical Specifications. All as-constructed survey documentation shall meet the requirements of Section 01050 of these Technical Specifications.

- B. Record Documents shall be accessible to the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, and QAO at all times during the construction period and shall be delivered to the QAO upon completion of the Work.
- C. Upon substantial completion of the Work, and prior to final acceptance, the CONTRACTOR shall complete and deliver five (5) complete sets and one (1) electronic copy of Record Documents to the QAO. The Record Documents shall consist of Contract Documents showing relevant corrections, modifications, and/or amendments, which accurately and fully report the location of the Work as constructed. The information submitted by the CONTRACTOR will be assumed to be reliable, and the QAO will not be responsible for the accuracy of such information, nor for any errors or omissions, which may appear on the Record Documents as a result.
- D. Record Documents submitted by the CONTRACTOR shall be sealed and signed by a Professional (civil) Engineer licensed and registered in the State of New Jersey. Final survey locations, elevations, and grades shall be sealed and signed by a Land Surveyor licensed and registered in the State of New Jersey.

1.08 MANUFACTURER'S INSTRUCTIONS

- A. For all equipment, special items, and materials as specified in individual Sections of these Specifications, submit five (5) copies of the manufacturer's printed warranties, instructions for delivery, storage, assembly, installation, start-up, adjusting, finishing, and spare parts list. All warranties shall be in the GROUP's name where applicable.
- B. Identify conflicts between manufacturer's instructions and the Contract Documents.

1.09 MANUFACTURER'S CERTIFICATES

- A. When specified in individual Sections of these Specifications, submit five (5) copies of manufacturer's certificates to the REMEDIAL DESIGNER for review.

- B. Indicate that the material or product conforms to or exceeds the specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product, if acceptable to REMEDIAL DESIGNER, unless current test results are called for in the Contract Documents.
- D. For all equipment and specialist materials, submit manufacturer's Warranties and Certifications together with vendor confirmation of assignment of all warranty rights to the GROUP, including full warranty period commencing from the date of final completion and acceptance of the Work by the GROUP.

1.10 TECHNICAL MANUAL SUBMITTAL

- A. The CONTRACTOR shall furnish the REMEDIAL DESIGNER with five (5) identical sets of Technical Manuals, also referred to as Operations and Maintenance (O&M) Manuals, for all mechanical, electrical, and instrumentation equipment. Each set shall consist of one or more volumes, each of which shall be bound in a standard size, 3-ring, loose leaf, and vinyl plastic hard cover binder suitable for bookshelf storage. A binder's ring size shall not exceed three (3) inches. The contents of the Technical Manual(s) shall be well organized to the satisfaction of the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, and QAO. Subsections of the Technical Manual shall be separated by dividers. A table of contents shall be provided which indicates all equipment and related information bound in the Technical Manuals. An electronic copy shall be provided in the latest version of Microsoft Word or other standard software, as appropriate.
- B. For each item requiring submittal of a Technical Manual, the CONTRACTOR shall include the following:
 - 1. Complete operating instructions, including location of controls, special tools or other equipment required, related instrumentation, and other equipment needed for operation.
 - 2. Lubrication schedules, including the lubricant SAE grade and type, temperature range of lubricants, and including frequency of required lubrication.
 - 3. Preventative maintenance procedures and schedules.
 - 4. Parts lists, by generic title and identification number, complete with exploded views of each assembly.
 - 5. Instructions for disassembling and reassembling.
 - 6. Name and location of nearest supplier and spare parts warehouse.
 - 7. Recommended troubleshooting procedures.
 - 8. Electronic files of the Record Drawings, including all survey drawings in AutoCAD 2004 or more recent version.
- C. All Technical Manuals shall be submitted in final form to the QAO not later than the seventy-five (75) percent construction completion date. The

CONTRACTOR shall correct all discrepancies or deficiencies identified by the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER or QAO, in the Technical Manual(s) and shall resubmit the documents within twenty-eight (28) calendar days from the date of written notification of the deficiencies.

1.11 SPARE PARTS LIST SUBMITTALS

- A. The CONTRACTOR shall furnish the QAO with five (5) identical sets of Spare Parts Lists for all mechanical, electrical, and instrumentation equipment, two (2) of which shall be transmitted to the operator. The Spare Parts Lists shall include the current list price of each spare part. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts to facilitate the operator in ordering. The CONTRACTOR shall cross-reference the spare parts list(s) to the equipment numbers designated in the Contract Documents. The spare parts list(s) shall be bound in standard size, 3-ring, loose leaf, and vinyl plastic hard cover binders suitable for bookshelf storage. A binder's ring size shall not exceed three (3) inches.

1.12 CONSTRUCTION PHOTOGRAPHIC DOCUMENTATION REPORT

- A. The CONTRACTOR shall submit the construction photographs in the form of a bound report. Each report shall consist of one (1) volume bound in a standard size, 3-ring, loose-leaf, and vinyl plastic hard cover binder suitable for bookshelf storage. A binder's ring size shall not exceed three (3) inches. Each copy of the Report shall include the requirements outlined in Section 01380.

1.13 EXCAVATION SUPPORT PLAN SUBMITTAL

- A. Prior to commencement of any Work requiring excavation to a depth in excess of the threshold limits of the OSHA regulations, the CONTRACTOR shall submit a detailed Excavation Support Plan to the REMEDIAL DESIGNER for review. This plan shall be designed and sealed by a Professional Engineer licensed and registered in the State of New Jersey. The Plan should include the design of any sheeting, shoring, bracing, sloping, or equivalent support method, in accordance with the requirements of Section 02150 of these Specifications. If so required, the Plan shall include appropriate measures to provide dewatering in accordance with Sections 02221 and 02402 of these Specifications. Excavation requiring support shall not be initiated until the REMEDIAL DESIGNER has favorably reviewed the CONTRACTOR's Plan. Favorable review of this Plan by the REMEDIAL DESIGNER shall not alleviate the CONTRACTOR of responsibility for all aspects of safety and compliance with applicable regulations during excavations.

1.14 SOIL AND WASTE DISPOSAL PLAN

- A. Prior to performing any subgrade preparation or excavation within the limits of waste shown on the Contract Drawings, the CONTRACTOR shall prepare and submit a Soil and Waste Disposal Plan to the REMEDIAL DESIGNER for

review in accordance with Article 1.04-A of Section 02221. This Plan shall indicate the proposed sequence for excavating waste; equipment to be used; approximate waste quantities; operational procedures such as hauling routes, placement, and compaction; procedures for managing and controlling surface water run-on and run-off; procedures for controlling, collecting, storing, and disposing of any leachate encountered; procedures controlling and mitigating odor, fugitive dust, and blowing litter; procedures and materials to be used for temporary cover over exposed waste; and health and safety protocols. The Plan shall specifically identify areas where waste excavation is expected and where excavated waste will be placed and show how areas of exposed waste at both excavation and fill areas will be minimized at all times. The Plan shall also provide details and plan drawings for temporary surface water run-on and run-off control features, leachate collection and storage, and typical operations for waste excavation and temporary cover placement over exposed waste areas. The Plan shall also include contingency procedures for handling of any drums or liquids that may be encountered, including monitoring requirements, overpacking methods, and procedures for control, collection, and disposal of liquids.

1.15 DECONTAMINATION/OFF-SITE DISPOSAL

- A. Prior to performing any excavation activities that will result in the decontamination and off-Site disposal of any ground structures, utilities, or waste, the CONTRACTOR shall submit a detailed schedule of proposed activities to the REMEDIAL DESIGNER for review. This schedule shall include a description of the means and methods of decontamination, and the name, address, and telephone number of the off-Site facility where the materials will be shipped for disposal. After disposal, the CONTRACTOR shall submit a copy of the disposal manifest to the QAO and the GROUP'S REPRESENTATIVE.

1.16 LIST OF EQUIPMENT AND PERSONNEL

- A. The CONTRACTOR shall provide the QAO with a listing of all construction equipment and construction personnel tabulated by day.
 - 1. The list of construction equipment shall include the manufacturer, model number, hours used, and component of the Work performed for all equipment on-Site. The initial submittal shall include hourly and weekly rental rates for each piece of equipment, as well as the hourly operating costs thereof.
 - 2. The list of construction personnel shall include employee name, job classification, hours worked, and component of the Work performed for all of the CONTRACTOR's employees and subcontractors that are not otherwise considered Site overhead.
 - 3. Health and Safety training certifications in accordance with the requirements of Section 01564 of these Specifications.
- B. The listing of construction equipment and construction personnel shall be submitted with each Application for Payment or submitted to the GROUP's

REPRESENTATIVE for review prior to mutual agreement regarding the Application for Payment. Any Applications for Payment without a complete listing of equipment and personnel will not be processed.

1.16 DAILY REPORTS

- A. The CONTRACTOR shall prepare daily reports summarizing on-Site activities.
- B. Daily reports shall include as a minimum the following information:
 - 1. Weather conditions;
 - 2. Active work area;
 - 3. Crew description;
 - 4. Subcontractor activity;
 - 5. Equipment operating;
 - 6. Hours worked;
 - 7. Work performed;
 - 8. Problems and resolutions;
 - 9. Health and safety issues;
 - 10. Visitors;
 - 11. Photographs taken;
 - 12. Videos made;
 - 13. QA/QC sampling/testing performed; and
 - 14. Air monitoring data.
- C. Daily reports shall be submitted to the GROUP'S REPRESENTATIVE and QAO the first working day following the report day.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

*****END OF SECTION*****

SECTION 01380

CONSTRUCTION PHOTOGRAPHS AND VIDEOS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The Work under this Section includes the CONTRACTOR's responsibility for providing construction photographs and videos consisting of color prints, slides, and videotapes showing the progression of the Work during the Contract period.
- B. The CONTRACTOR shall provide, at the CONTRACTOR's own expense, all labor, equipment, materials, processing, and associated appurtenances to complete the Work associated with providing construction photographs and videos.

1.02 RELATED SECTIONS

- A. Section 01300 – Submittals
- B. Section 01720 – Record Documents

1.03 SUBMITTALS

- A. The CONTRACTOR shall submit a Construction Photographic and Video Documentation Plan each month to the GROUP's REPRESENTATIVE for approval. The following information shall be provided in each monthly plan at a minimum:
 - 1. List of items/activities photographed and videotaped;
 - 2. Locations of photographs and video depicted on a large-scale Site map;
 - 3. Date and approximate time the photographs and video will be taken; and
 - 4. Items to be photographed and videotaped next month based on the scheduled activities.
- B. The CONTRACTOR shall submit five (5) copies of monthly Construction Photographic and Video Documentation Reports, conforming to the requirements of Article 1.04 herein, to the OWNER's REPRESENTATIVE within ten (10) days after the last day of photography covered by the monthly Construction Photographic and Video Documentation Plan.

1.04 GENERAL REQUIREMENTS

- A. All construction photographs shall be of clear professional quality and include a scale or other dimensional reference and the date the photo was taken within the frame of all items/activities photographed. A chronological photographic log shall be maintained by the CONTRACTOR and include, at a minimum for each photo the film roll and exposure number, date and time of exposure, description

of the item/activity being photographed, and the orientation of the view. Digital photography may be used and is encouraged.

- B. All construction videos shall be of clear professional quality and include the date and time within the frame of all items/activities videotaped. A chronological videotape log shall be maintained by the CONTRACTOR and include, at a minimum for each videotape, the date(s) and time(s) of videotaping, description of the item/activity being videotaped, and video identification number.
- C. Photographic prints shall be color, 3-inch by 5-inch, on single weight paper with a smooth, glossy surface finish, except one (1) record copy shall be 8-inch by 10-inch. Slides shall be color 35mm.
- D. Videos shall be in a color, high-quality format, and provided on DVD..
- E. Construction Photographic and Video Documentation Report: The CONTRACTOR shall submit its monthly construction photographs and video in the form of a bound report. Each report shall consist of one (1) or more volumes, each of which shall be bound in a standard size, 3-ring, loose-leaf, and vinyl plastic hard cover binder suitable for bookshelf storage. A binder's ring size shall not exceed three (3) inches. Each copy of the monthly report shall include the following:
 - 1. Cover sheet containing the title, "Monthly Construction Photographic and Video Documentation Plan," time period covered by the report, the project title and number, the CONTRACTOR's name and address, date of submittal, and the name and address of the photographer/videographer, if applicable.
 - 2. The monthly Construction Photographic and Video Documentation Plan for the period covered by the submitted photographs and videotapes.
 - 3. Photographic log: The photographic log shall conform to Article 1.04-A herein.
 - 4. Videotape log: The videotape log shall conform to Article 1.04-B herein.
 - 5. Key map: The key map shall consist of a large-scale Site map with the location and identification of each photograph and videotaped item or activity depicted on the map.
 - 6. Prints: Prints shall be mounted on letter-size pages, single sided, with a maximum of two (2) prints mounted per page. Each print shall be accompanied by a caption that includes the project title and number, the item/activity being photographed, the orientation of the view, and the date and time of exposure. The 8" x 10" photographs shall be mounted one (1) per page in a special record copy report.
 - 7. Slides: Slides shall be identified by a number on the slide referenced to the photographic log containing the same identification information as used for the prints. Slides shall be mounted in clear plastic, loose-leaf slide mounts consisting of top-loading slide pockets with a maximum of twenty (20) slides per single sided page.

8. Videos shall be identified by labels affixed to each DVD and DVD cover. The labels shall be clearly and indelibly marked with the project title and number, date of submittal, title (i.e., Construction Photographic and Video Documentation Report), and the video identification number.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.01 PRE-CONSTRUCTION PHOTOS AND VIDEOS

- A. Prior to commencement of the Work, the CONTRACTOR shall photograph and videotape the existing Site conditions. Pre-construction photos and videos shall include, but are not necessarily limited to, the following items:
 1. Areas of future construction or special interest;
 2. Areas designated as temporary and permanent easements;
 3. Locations of temporary Site facilities;
 4. Laydown, staging, and storage areas;
 5. Equipment decontamination pad areas;
 6. Contaminant reduction zones;
 7. Fence locations;
 8. Utilities, including overhead lines; and,
 9. Site access locations.
- B. Immediately prior to commencing any construction activities, an aerial photograph depicting pre-construction conditions shall be taken and submitted in accordance with the requirements of this Section.

3.02 PROGRESS PHOTOS AND VIDEOS

- A. During the progress of the Work, all major work activities shall be photographed and videotaped as necessary to provide complete documentation. For each monthly Construction Photographic and Video Documentation Report, a minimum of thirty-six (36) photos and one (1) video shall be taken with a maximum of seventy-two (72) photos and two (2) videos. Progress photos and videos shall include, but are not necessarily limited to, the following items:
 1. Mobilization;
 2. Construction of temporary facilities, utilities, access roadways, and security fences/gates;
 3. Construction of temporary and permanent erosion control measures;
 4. Construction of decontamination facilities;
 5. Excavation and backfill activities;
 6. Installation of the enhanced groundwater extraction system;

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7. Installation of the steel sheet pile wall;
8. Performance of the specified In-situ "Hot Spot" treatment work;
9. Construction of the specified cover system;
10. Other activities considered important in demonstrating the Work progress; and
11. Demobilization.

- B. During the progress of the Work, special conditions and/or circumstances may arise requiring additional photographic and video documentation. The CONTRACTOR shall perform additional photography, videotaping, and reporting as directed by the REMEDIAL DESIGNER.

3.03 POST-CONSTRUCTION PHOTOS

- A. Upon completion of the Work, the CONTRACTOR shall photograph and videotape the Site from the same locations, and include the same features, as the photographs and videos used to document the existing, pre-Work Site conditions as outlined in Article 3.01 herein.

END OF SECTION

SECTION 01400

QUALITY CONTROL

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The Work under this Section describes the CONTRACTOR's responsibility for providing all Quality Control testing and inspection, as necessary, for the proper and complete performance of the Work.
- B. The CONTRACTOR shall comply with the Quality Control testing and inspection requirements herein, and as otherwise specified in individual Sections of these Technical Specifications.

1.02 SUBMITTALS

- A. CONTRACTOR shall provide the qualifications of the subcontractor/personnel providing quality control for the Work, and all quality control testing results shall be submitted to the GROUP's REPRESENTATIVE and QUALITY ASSURANCE OFFICER (QAO).
- B. Submit in accordance with Section 01300 of these Technical Specifications.

1.03 RELATED SECTIONS

- A. 01300 – Submittals
- B. 02125 – Erosion and Sediment Control
- C. 02223 – Backfill and Fill
- D. 02224 – Cover Soil
- E. 02225 – Vegetative Support Layer
- F. 02233 – Aggregate Materials
- G. 02274 – Stone Riprap
- H. 02450 – In-Situ "Hot Spot" Treatment
- I. 02460 – Steel Sheet Piling
- J. 02590 – Geomembranes
- K. 02595 – Geotextiles
- L. 02598 – Geosynthetic Clay Liner
- M. 02599 – Geocomposite Drainage Layer

1.04 QUALITY CONTROL OF INSTALLATION

- A. The CONTRACTOR shall monitor Quality Control over products, services, Site conditions, and workmanship for conformance with the Contract Documents.
- B. The CONTRACTOR shall comply fully with manufacturer's instructions, including each step in any prescribed sequence.

- C. Should the manufacturer's instructions conflict with the Contract Documents, the CONTRACTOR shall request clarification from the REMEDIAL DESIGNER before proceeding.
- D. The CONTRACTOR shall comply with specified standards, as a minimum quality, for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. The CONTRACTOR shall perform Work with persons qualified to produce workmanship of specified quality.

1.05 REFERENCES

- A. Conform to the referenced standards that are in effect as of the date for receiving bids.
- B. Obtain copies of referenced standards, when required by the Contract Documents.
- C. Should specified referenced standards conflict with the Contract Documents, request clarification from the REMEDIAL DESIGNER before proceeding.
- D. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by either mention or inference in any referenced standard.

1.06 INSPECTION AND TESTING LABORATORY SERVICES

- A. The CONTRACTOR is responsible for performing and documenting all Quality Control tests. The GROUP will appoint, employ, and pay for services of a QUALITY ASSURANCE OFFICER (QAO) to perform Quality Assurance inspection and testing.
- B. The QAO and the CONTRACTOR will perform inspections, tests, and services, as required by these Specifications.
- C. Reports will be submitted by the QAO and the CONTRACTOR to the GROUP's REPRESENTATIVE, indicating observations and results of tests and indicating compliance or non-compliance with the Contract Documents.
- D. The CONTRACTOR shall cooperate with the QAO to furnish samples of materials, design mixes, equipment, tools, storage and assistance as requested.
 - 1. Notify the QAO at least forty-eight (48) hours prior to the expected time for operations requiring quality assurance services.
 - 2. Make arrangements with the QAO, and pay for additional samples and tests required for the CONTRACTOR's use.
- E. Re-testing or re-inspection required because of deficiencies in the Work, shall be performed by the CONTRACTOR on instructions by the GROUP's REPRESENTATIVE or QAO. Payment for re-testing or re-inspection may be

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charged by the GROUP to the CONTRACTOR by deducting re-inspection or re-testing charges from the Contract Price.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

*****END OF SECTION*****

SECTION 01410

MATERIAL TESTING LABORATORY

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. This Section provides the certifications and approvals required by material testing laboratories to be utilized by the CONTRACTOR, and all subcontractors performing material testing during the Work.
- B. Material testing includes earthen materials and other materials requiring engineering property testing as described in the Contract Documents, and as required herein.
- C. Engineering property testing includes testing of materials and other necessary testing described within individual Sections of the Contract Documents, and as required herein.
- D. The laboratories utilized during the Work for engineering property testing, including environmental analytical, geotechnical, and geosynthetic testing, shall be approved by the GROUP's REPRESENTATIVE and/or the REMEDIAL DESIGNER.
- E. The CONTRACTOR shall provide a "Competent Person" to implement, supervise and inspect all Work.

1.02 SUBMITTALS

- A. The CONTRACTOR shall submit to the REMEDIAL DESIGNER for favorable review, the qualifications of the subcontractor/personnel providing these services.
- B. Submit in accordance with Section 01300 of these Technical Specifications.

1.03 RELATED SECTIONS

- A. 01300 – Submittals
- B. 01400 – Quality Control
- C. 01563 – VOC, Odor, Vector and Spill Control
- D. 01564 – Health and Safety
- E. 02060 – Demolition
- F. 02125 – Erosion and Sediment Control
- G. 02221 – Soil and Waste Disposal
- H. 02223 – Backfill and Fill

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- I. 02224 – Cover Soil
- J. 02225 – Vegetative Support Layer
- K. 02233 – Aggregate Materials
- L. 02274 – Stone Riprap
- M. 02402 – Liquids Handling and Disposal
- N. 02450 – In-Situ “Hot Spot” Treatment
- O. 02590 – Geomembranes
- P. 02595 – Geotextiles
- Q. 02598 – Geosynthetic Clay Liner
- R. 02599 – Geocomposite Drainage Layer

1.04 TESTING LABORATORY RESPONSIBILITIES

- A. Cooperate with the GROUP’s REPRESENTATIVE, REMEDIAL DESIGNER, QUALITY ASSURANCE OFFICER (QAO), and the CONTRACTOR.
- B. Provide qualified personnel promptly on notice.
- C. Perform specified inspections, sampling, and testing of materials as required during construction.
 - 1. Comply with specified standards, the American Society of Testing and Materials (ASTM), or other recognized authorities and accepted standards, and as specified.
 - 2. Ascertain compliance with requirements of Contract Documents.
- D. Promptly notify the QAO and the CONTRACTOR of any irregularities or deficiencies in the Work, which are observed during the performance of testing services.
- E. Submit five (5) copies (four (4) copies to the QAO and one (1) copy to the CONTRACTOR) of reports of inspections and tests, in addition to those additional copies required by the CONTRACTOR, with the following information included:
 - 1. Date issued;
 - 2. Project title and number;
 - 3. Location of Project;
 - 4. Testing laboratory name and address;
 - 5. Name and signature of inspector or analyst;
 - 6. Date of inspection or sampling and testing;
 - 7. Climatic data (temperature, humidity, etc.);
 - 8. Date the test was executed;
 - 9. Identification of product and relevant Specification Section;
 - 10. Type of inspection or test;
 - 11. Results of test; and,
 - 12. Observations regarding compliance with Contract Documents.

Reports of inspections and tests shall be promptly processed and distributed (within two (2) calendar days after test or inspection completion, unless otherwise noted) to the CONTRACTOR and QAO to ensure all necessary re-testing or replacement of materials with the least possible delay in progress of the Work.

- F. Perform additional services as required.
- G. The Materials Testing Laboratory shall not be authorized to:
 - 1. Release, revoke, alter, or enlarge on the requirements of Contract Documents.
 - 2. Approve or accept any portion of the Work.

1.05 CONTRACTOR RESPONSIBILITIES

- A. Cooperate with laboratory personnel; provide access to the Work; and furnish the laboratory with the relevant Technical Specification and manufacturer's requirements/specifications for items to be tested, as required.
- B. Provide representative samples of materials to be tested to the laboratory in sufficient/required quantities.
- C. Furnish copies of manufacturer test reports/certifications to the laboratory and as required by the QAO.
- D. Furnish required labor and facilities to provide the laboratory with:
 - 1. Access to the Work to be tested;
 - 2. Assistance in obtaining and handling samples at the Site, as required;
 - 3. The means to facilitate inspections and testing; and,
 - 4. Sampling holding and storage boxes as needed.
- E. Notify the laboratory at least twenty-four (24) hours in advance of any construction activities requiring inspection, sample collection, and testing to allow the laboratory sufficient time for assignment of personnel and scheduling of testing programs.
- F. Where testing is to be conducted by an independent laboratory, the sample(s) shall be selected by such laboratory, or the QAO, and shipped to the laboratory by the CONTRACTOR at the CONTRACTOR's expense.
- G. Copies of all correspondence between the CONTRACTOR and laboratory shall be provided to the QAO.

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1.06 QUALITY ASSURANCE

- A. Testing will be in accordance with all pertinent codes and regulations and with procedures and requirements of the ASTM, or other recognized authorities.

1.07 TESTING/RE-TESTING SERVICES

- A. When initial tests performed by the laboratory indicate nonconformance with the Contract Documents, all subsequent re-testing occasioned by the nonconformance shall be performed by the same testing laboratory. The costs associated with any re-testing, including the costs for the initial tests, shall be at the CONTRACTOR's own expense.
- B. Inspections and tests required by codes or ordinances, or by a plan approval authority, and made by a legally constituted authority, shall be the responsibility of the CONTRACTOR, and at the CONTRACTOR's own expense, unless otherwise provided in the Contract Documents.
- C. Inspection or testing performed exclusively for the CONTRACTOR's convenience shall be the sole responsibility of the CONTRACTOR and at the CONTRACTOR's own expense.

1.08 SCHEDULES FOR TESTING

- A. Establishing Schedule
 - 1. The CONTRACTOR shall, by advance discussion with the selected testing laboratory, determine the time required for the laboratory to perform its tests and to issue each of its findings.
 - 2. The CONTRACTOR is responsible for making all arrangements to have the testing laboratory on-Site to provide the required testing as construction activities require.
 - 3. The CONTRACTOR's Construction Schedule shall include the required time for testing services.
- B. When changes to the Construction Schedule are necessary during construction, coordinate all such changes of schedule with the testing laboratory.

1.09 SAMPLE/SPECIMEN COLLECTION AND TRANSPORT

- A. All specimens and samples for testing will be collected by the CONTRACTOR, unless otherwise specified in the Contract Documents.
- B. The CONTRACTOR shall be responsible for the protection and transportation of all collected specimens and samples, except those taken by the testing laboratory personnel, to the testing laboratory.

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PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

*****END OF SECTION*****

SECTION 01540

JOB SITE SECURITY

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall be responsible for all job Site security. Whenever evidence is found of damage to the Work, the CONTRACTOR shall immediately remove the damaged portion and replace it with satisfactory Work at the CONTRACTOR's expense. A copy of all accident reports shall be submitted to the QUALITY ASSURANCE OFFICER (QAO) within twenty-four (24) hours or the next business day.
- B. The CONTRACTOR shall keep a daily record of personnel and visitors at the Site including arrival and departure times. Provide records to the QAO on a weekly basis.
- C. The CONTRACTOR's responsibility for the maintenance of job Site security shall not cease until the Work has been accepted by the GROUP.

1.02 RELATED SECTIONS

- A. 01550 – Site Access and Traffic Control

1.03 BARRICADES, LIGHTS, AND SIGNALS

- A. The CONTRACTOR shall furnish and erect such barricades, fences, flagmen, watch guards, lights, danger signals, and such other precautionary measures to protect persons, property, and the Work as necessary to comply with Federal, State, and local regulations. Barricades shall be painted in a color, or utilize other measures, to ensure visibility at night. From sunset to sunrise, the CONTRACTOR shall furnish and maintain at least one operable light at each barricade. Sufficient numbers of barricades shall be erected to keep vehicles from being driven into, and persons from walking onto, construction areas.
- B. Damage to the Work due to inadequate job site security is the sole responsibility of the CONTRACTOR. Whenever evidence is found of such damage to the Work, the CONTRACTOR shall immediately remove the damaged portion and replace it at CONTRACTOR's expense. The CONTRACTOR's responsibility for the maintenance of job Site security shall not cease until the Work has been accepted by the GROUP.
- C. The CONTRACTOR shall control vehicle access, in accordance with Section 01550 of these Specifications, to the Site at all times when the Work is in progress. At the end of each workday, the CONTRACTOR shall secure access to the Site, and shall provide security as specified herein.

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1.04 SITE ACCESS, SECURITY, AND RESTRICTIONS

- A. Immediately upon mobilization to Site, the CONTRACTOR shall assume the responsibility and cost of Site security through the completion of the Work, including periods of no construction activity. This includes, but is not limited to, access control, installation of temporary protective fencing and gates (as required), fence inspection and repair, barricades around excavated areas, and other necessary measures to restrict public access to Site until the Work is completed and accepted by the GROUP. CONTRACTOR shall coordinate with the GROUP REPRESENTATIVE to establish guidelines for personnel access to the Site. CONTRACTOR shall be fully responsible for maintaining site security from the time of Notice to Proceed to completion of the Work including periods of no construction activity.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

*****END OF SECTION*****

SECTION 01550

SITE ACCESS AND TRAFFIC CONTROL

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall furnish all materials, labor, equipment, tools, and appurtenances required to maintain Site access and traffic control. Traffic congestion around the Site shall be minimized to maintain public safety, and to minimize the potential for complaints from the public. The CONTRACTOR shall be responsible for any direct or indirect damages arising from inadequate traffic control at off-Site areas nearby the Site which are used as transportation routes for the Work.
- B. The CONTRACTOR shall comply with all applicable codes, ordinances, rules, regulations and laws of local, State, and Federal authorities having jurisdiction. This includes, but is not limited to, compliance with traffic laws, and with vehicular weight and axle-loading limitations.
- C. The CONTRACTOR's responsibility for the maintenance of Site access and traffic control shall not cease until the Work has been accepted by the GROUP.
- D. The CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect all Work.
- E. The CONTRACTOR shall comply with local and state notifications and coordination, as may be necessary, for roadway closure, continual site access, traffic control, and public safety.

1.02 RELATED SECTIONS

- A. 01540 – Job Site Security
- B. 02125 – Erosion and Sediment Control

1.03 SUBMITTALS

- A. Within fifteen (15) business days after receipt of the Notice to Proceed, and prior to mobilization to the Site, the CONTRACTOR shall develop and submit to the REMEDIAL DESIGNER a Site Access and Traffic Control Plan in accordance with the requirements of Section 01300 of these Technical Specifications, and as specified herein.
- B. The Site Access and Traffic Control Plan shall include, but not be limited to, proposed traffic patterns and layouts, frequency and routes of material delivery to the Site, required traffic control devices (i.e., signs, barricades, cones, etc.) and utilization, hours of operation, and other associated details for the proper maintenance and protection of traffic.

- C. Submit in accordance with Section 01300 of these Technical Specifications.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

3.01 SITE ACCESS

- A. All traffic shall access the Site from Paterson Plank Road as shown on the Drawings. Hauling and on-Site work shall be conducted between the hours of 7:00 a.m. and 7:00 p.m., Monday through Friday and between 8:00 a.m. and 7:00 p.m. on Saturday. Extended hauling and work hours and weekend hauling and work shall be subject to the approval of the Borough of Carlstadt, the GROUP and the GROUP's REPRESENTATIVE.

3.02 OFF-LOADING

- A. Coordinate with the GROUP's REPRESENTATIVE and/or QUALITY ASSURANCE OFFICER (QAO) to select the areas to be used for off-loading and temporary storage of materials. Clearly delineate the boundary of all storage and laydown areas.
- B. To minimize tracking of soils off-site, the CONTRACTOR shall construct temporary rock entrances as required by the Contract Drawings. In addition, dumping of soils shall be done in a manner that minimizes wheel contact with the soils. Off-loading of materials on the Site shall be coordinated with construction of temporary access roads.
- C. If soil is tracked onto public roads from the CONTRACTOR's operations, the CONTRACTOR shall take immediate action, as needed, to correct this problem to the satisfaction of the GROUP'S REPRESENTATIVE.

3.03 COVERING OF MATERIALS

- A. All trucks used for transport of soils shall be covered with a well-secured tarp before transportation on public roads. The CONTRACTOR shall take such steps as necessary to prevent spillage, wind blown deposits on the roads, and damage to other vehicles.
- B. After dumping imported soil materials at the Site, the CONTRACTOR shall inspect the truck bed for residual materials and shall remove or cover residual material before allowing the truck to leave the Site and entering public roads.

3.04 STREET CLEANING

- A. Remove all soils, dirt, rock, asphalt, and other deposits that accumulate on the public roads and on-site access roads, which are a result of the CONTRACTOR's activities. This includes windblown deposits, spillage, and materials tracked onto the roads. Removal shall be accomplished by sweeping and washing, as required.
- B. Inspection of the roads is to be performed by the CONTRACTOR at least daily during hauling operations. When the inspection determines that cleaning is required, or as directed by the GROUP's REPRESENTATIVE or QAO, the CONTRACTOR shall immediately perform such cleaning.

3.05 TRAFFIC CONTROL ON PUBLIC ROADS

- A. The CONTRACTOR shall not impair traffic on public or private roads.
- B. The CONTRACTOR shall maintain the current level-of-service on public roads in proximity to the Site. Provide flagmen or other means of traffic control when and where necessary, or when requested by the GROUP's REPRESENTATIVE or QAO, to maintain adequate safety for both public and construction vehicles, and to avoid interruptions to the current level-of-service and adverse impacts or delays to the Work. The flagmen on public roads may have to be police officers and CONTRACTOR shall coordinate and pay for their service.
- C. CONTRACTOR shall maintain the existing public roadway adjacent to the Site so that it is in service throughout the construction. Damage to the roadway as a result of construction activities shall be restored and/or replaced to the satisfaction of the GROUP's REPRESENTATIVE and/or QAO, at the CONTRACTOR's expense to a condition equal to or better than that prior to construction.
- D. CONTRACTOR shall perform maintenance and periodic repairs, as necessary, for public roadways to allow safe and usable passage for normal traffic. "Usable passage" for the purposes of this project shall mean a sufficiently smooth roadway surface that will not impose above normal "wear and tear" on non-CONTRACTOR owned/operated vehicles using the roadways.

3.06 ON-SITE TRANSPORTATION

- A. The control of on-site traffic is solely the CONTRACTOR's responsibility and shall be performed in a safe and orderly manner. The access road shall be maintained by the CONTRACTOR to prevent adverse impacts or delays to the Work.
- B. Access roads shall be constructed and maintained by the CONTRACTOR to prevent adverse impacts or delays to the Work. The CONTRACTOR is responsible for maintaining the current level-of-service and condition of the on-Site access roads to prevent adverse impacts or delays to the Work.

- C. Damage to, or deterioration of, the Site's access roads, or any other damages to existing on-Site features caused by unauthorized deviation from these pathways, shall be restored and/or replaced to the satisfaction of the GROUP's REPRESENTATIVE and/or QAO, at the CONTRACTOR's expense to a condition equal to or better than that prior to construction.

*****END OF SECTION*****

SECTION 01562

DUST CONTROL

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall employ means and methods that keep airborne particulates to the minimum during construction. This includes providing all labor, equipment, machinery, and materials for the application of water or other appropriate preventative means or methods to maintain dust control and to minimize the potential for complaints from the public.
- B. The CONTRACTOR shall comply will all applicable codes, ordinances, rules, regulations and laws of local, State, and Federal authorities having jurisdiction.
- C. The CONTRACTOR shall provide a Competent Person to implement, supervise, and inspect all Work. The QUALITY ASSURANCE OFFICER (QAO) shall monitor implementation of the Work.

1.02 HEALTH AND SAFETY

- A. Site workers shall not be exposed to respirable particulates caused by the performance of the Work in excess of applicable Federal and State standards.
- B. Airborne particulates shall be monitored in accordance with the Site-specific Health and Safety Plan, and the requirements of Section 01564 of these Technical Specifications.

1.03 RELATED SECTIONS

- A. 01550 – Site Access and Traffic Control
- B. 01564 – Health and Safety
- C. 02100 – Site Preparation
- D. 02110 – Site Clearing and Grubbing
- E. 02125 – Erosion and Sediment Control
- F. 02210 – Site Grading
- G. 02220 – Excavation
- H. 02221 – Soil and Waste Disposal
- I. 02223 – Backfill and Fill
- J. 02224 – Cover Soil
- K. 02225 – Vegetative Support Layer

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PART 2 – PRODUCTS

2.01 GENERAL

- A. Clean water shall be used for dust control. The CONTRACTOR shall provide the name and location of the water source, and evidence that the water is clean, to the GROUP's REPRESENTATIVE.
- B. Dust control shall be applied immediately when conditions warrant and as directed by the GROUP's REPRESENTATIVE or the QAO. A sufficient quantity of clean water and appropriate equipment shall be maintained on-site for immediate dust control use.
- C. The use of calcium chloride for dust control is not permitted on the Site.

PART 3 – EXECUTION

3.01 GENERAL

- A. Watering equipment shall be used to minimize airborne particulate concentrations and shall consist of pipelines, tanker trucks, or other devices acceptable to the GROUP's REPRESENTATIVE. This equipment shall be capable of applying a uniform spread of water over the ground surface. A suitable device for a positive shut-off and for regulating the flow rate of water shall be located so as to afford unhindered operator control.

*****END OF SECTION*****

SECTION 01563

VOC, ODOR, VECTOR AND SPILL CONTROL

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall provide all labor, equipment, machinery, and materials required to apply volatile organic compound (VOC), odor, vector and spill control media to exposed soils and/or waste materials impacted by said spills and/or to mitigate the release of odors, which result in nuisance complaints from the surrounding community or violate air monitoring threshold limits specified in the CONTRACTOR'S approved Site-specific Health and Safety Plan (HASP), as required in Section 01564.
- B. The CONTRACTOR shall minimize the extent and duration of open excavations to reduce the potential for releasing odors and VOCs. The CONTRACTOR shall be fully responsible for the proper and timely implementation of VOC, odor, vector, and spill control measures.
- C. Odor control shall include application and maintenance of suitable soil cover and/or plastic cover as a first course of action. If the soil or plastic is insufficient, the CONTRACTOR shall furnish and apply foam control or deodorizing agents as approved by the GROUP'S REPRESENTATIVE. The CONTRACTOR shall maintain VOC, odor, and vector control media at the Site for immediate use, as required.
- D. The CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect all Work. The QUALITY ASSURANCE OFFICER (QAO) shall monitor satisfactory implementation of the Work.
- E. VOCs, odors, vectors, and spills shall be controlled according to applicable local, State, and Federal regulations.

1.02 SUBMITTALS

- A. Within fifteen (15) business days after receipt of the Notice to Proceed, and prior to mobilization onto the Site, CONTRACTOR shall develop and submit to the GROUP'S REPRESENTATIVE and REMEDIAL DESIGNER a VOC, Odor, Vector, and Spill Control Plan for favorable review, and this plan shall be incorporated into CONTRACTOR's approved Site-specific HASP.
- B. This VOC, Odor, and Vector Control Plan shall include, but not be limited to, Site perimeter and Work-specific air and VOC monitoring equipment, procedures, and frequencies; limitations of open excavations and procedures and

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schedules for placing temporary cover over exposed waste; proposed deodorizing agents and procedures for their application; procedures for fire control and emergency response and public notification of releases of hazardous materials.

- C. CONTRACTOR shall submit material specification, material safety data sheets, and product samples for all VOC, Odor, Vector, and Spill Control/Containment media produced intended for use on Site, as defined herein or on the Contract Drawings or as determined necessary by CONTRACTOR.
- D. CONTRACTOR shall not be allowed to mobilize onto the Site until its submitted VOC, Odor, Vector, and Spill Control and HASP plans has been reviewed and approved.
- E. Submit in accordance with Section 01300 of these Technical Specifications.

1.03 RELATED SECTIONS

- A. 01300 – Submittals
- B. 01562 – Dust Control
- C. 01564 – Health and Safety
- D. 02100 – Site Preparation
- E. 02110 – Site Clearing and Grubbing
- F. 02125 – Erosion and Sediment Control
- G. 02210 – Site Grading
- H. 02220 – Excavation
- I. 02221 – Soil and Waste Disposal
- J. 02223 – Backfill and Fill
- K. 02224 – Cover Soil
- L. 02225 – Vegetative Support Layer
- M. 02402 – Liquids Handling and Disposal

PART 2 – PRODUCTS

2.01 VOC/ODOR CONTROL MEDIA

- A. Temporary odor control media to be applied by the CONTRACTOR may include cover soil, plastic, foam agent, or other material approved by the GROUP'S REPRESENTATIVE.
- B. Cover soil shall be in accordance with Section 02224 of these Specifications.

2.02 SPILL CONTAINMENT MEDIA

- A. Temporary spill containment media to be immediately available for application by the CONTRACTOR shall include, but not be limited to, temporary berms or sumps, sorbent drum collars, dikes, granular material (e.g., Speedi Dry) and pre-

packaged synthetic sorbents (pillows, socks and swabs). Sorbents shall be capable of containing both aqueous and hydrophobic (oily) spills.

PART 3 – EXECUTION

3.01 PLACEMENT OF VOC AND ODOR CONTROL MEDIA

- A. CONTRACTOR shall implement and maintain Site-specific perimeter and Work-specific air monitoring procedures, in accordance with its approved HASP, and implementation of VOC, Odor, Vector, and Spill control measures shall be directly tied to Site-specific action/limit threshold, as defined in CONTRACTOR's approved HASP and VOC, Odor, Vector, and Spill Control plans.
- B. All VOC, Odor, Vector, and Spill control measures shall be implemented in accordance with CONTRACTOR's approved VOC, Odor, Vector, and Spill Control and HASP plans.
- C. Excavated materials containing debris, visibly contaminated soil, and other material emitting odors shall, if disturbed during the course of construction activities and found to give off odors, be covered with soil, plastic, foam agent, or other material approved by the GROUP'S REPRESENTATIVE until such time as final grading can be accomplished. The CONTRACTOR shall maintain the integrity of the temporary cover measure until the final materials have been placed and approved by the GROUP'S REPRESENTATIVE.
- D. Odor control media shall be placed over disturbed areas by the CONTRACTOR immediately upon the detection of odors or at the direction of the GROUP'S REPRESENTATIVE.
- E. Areas that have received odor control foam shall not be left exposed for more than twenty-four (24) hours, or any alternative period of time determined by the GROUP'S REPRESENTATIVE to be appropriate, without receiving a subsequent application of foam or soil until construction in that area has been completed.
- F. Odor control foam shall be applied in accordance with manufacturer's recommendations. Following application, the CONTRACTOR shall limit traffic over the area of application to limit disruption of the foam layer and subsequent potential release of odors. If necessary, the CONTRACTOR shall reapply foam to areas that have been disturbed by construction activities, or where the foam is more than twenty-four (24) hours old, at no cost to the GROUP.
- G. The GROUP's REPRESENTATIVE shall be the final judge in determining if odor control is adequate. If the CONTRACTOR is unable to control odor, Work may be stopped at the discretion of the GROUP's REPRESENTATIVE. The CONTRACTOR shall not be granted extensions of time or reimbursement for any delays so caused.

- H. Used sorbents including pillows, socks, and swabs shall be placed in drums and disposed in an off-site facility in accordance with all applicable local, State, and Federal rules and regulations at no cost to the GROUP's REPRESENTATIVE, in accordance with Section 02402 of these Technical Specifications.
- I. The CONTRACTOR shall recover spilled solid wastes using scoops or shovels, and shall return the solid wastes to the landfill for disposal under the cap.
- J. Disturbed wastes shall not be left exposed for more than eight (8) hours regardless of VOC or odor emissions.

3.02 PLACEMENT OF FIRE CONTROL MEDIA

- A. Excavated materials which present a severe fire risk or in which a fire has started shall be immediately covered with fire control foam or soil until the fire is extinguished or the risk has been otherwise mitigated. The CONTRACTOR shall immediately contact the local fire emergency response authorities, and shall maintain the integrity of the temporary fire control measure until the final materials have been placed and approved by the GROUP's REPRESENTATIVE.
- B. Fire control media shall be placed over the fire or potential fire hazard areas by the CONTRACTOR immediately upon the discovery of fire or a potential fire hazard, or at the direction of the GROUP's REPRESENTATIVE.
- C. Fire control foam shall be applied in accordance with the manufacturer's recommendations. Following application, the CONTRACTOR shall immediately contact the local fire and police departments, and shall restrict traffic within the area of the fire. If necessary, the CONTRACTOR shall reapply foam until the fire department arrives on-Site.
- D. The fire department, along with the GROUP's REPRESENTATIVE, shall be the final judge in determining if fire control is adequate, and that a potential for another fire does not exist. Upon completion of fire suppression, Work may be stopped at the discretion of the GROUP's REPRESENTATIVE. CONTRACTOR shall not be granted extensions of time or reimbursement for any delays so caused.
- E. The CONTRACTOR shall maintain at all times an adequate supply of soil to be used to deactivate and smother reactions caused by inadvertent mixing of reactive or incompatible materials.

3.03 EMERGENCY RESPONSE/NOTIFICATION OF RELEASES

- A. If VOCs exceed the threshold levels, as defined in CONTRACTOR's approved HASP, or potentially hazardous materials and/or liquids are released/spilled on-Site, CONTRACTOR shall immediately notify the GROUP's REPRESENTATIVE, and if appropriate, the GROUP's REPRESENTATIVE will contact appropriate governmental agencies.

- B. In addition, CONTRACTOR shall submit written reports to the GROUP's REPRESENTATIVE within twenty-four (24) hours of discover of any releases of potentially hazardous materials on-Site or exceeded perimeter air monitoring threshold limits. These reports shall sufficient describe, as necessary, the events that occurred and the corrective actions implemented, or to be taken, to mitigate further releases or threatened endangerment, and to prevent reoccurrence of such releases. The reporting requirements under Section 103(c) of CERCLA, 42 U.S.C. § 9603(c), and Section 304 of the Emergency Planning and Community Right-To-Know Act of 1986 42 U.S.C. § 11004 shall be followed.

*****END OF SECTION*****

SECTION 01564

HEALTH AND SAFETY

PART 1 – GENERAL

1.01 PURPOSE

- A. The purpose of this Section is to establish minimum health and safety requirements for the CONTRACTOR to satisfy in the preparation of the CONTRACTOR's Site-specific Health and Safety Plan (HASP).

1.02 APPLICABILITY

- A. These requirements shall be used by the CONTRACTOR's designated Health and Safety Officer (HSO) to assist in preparation of the CONTRACTOR's HASP. These requirements shall not relieve the CONTRACTOR from compliance with any applicable local, State, Federal, or other health and safety requirements and safe construction practices even if not specifically identified in these requirements. These requirements shall not relieve the CONTRACTOR's complete responsibility for the Site's safety and security, including Health and Safety.
- B. If, at any time, the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, or QUALITY ASSURANCE OFFICER (QAO) is apprised of a safety hazard which demands immediate attention because of its high potential for harm to public travel, persons on or about the Work, or public or private property, the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, or QAO shall have the right to order such safeguards to be erected and such precautions to be taken as they deem necessary. The CONTRACTOR shall comply with such orders. In particular, the CONTRACTOR shall take appropriate measures to protect workers from direct or indirect contact with groundwater and waste materials within the limits of the Site. Furthermore, the CONTRACTOR shall take appropriate measures to protect workers from oxygen-deficient or explosive atmospheres that may be present in excavations and other confined spaces.
- C. If, under such circumstances, the CONTRACTOR does not or cannot immediately put the Work into proper and approved condition, or if the CONTRACTOR or his representative is not on the Site so that he can be notified immediately of the insufficiency of safety precautions, then the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, or QAO may put the Work into such a condition that it shall be, in its opinion, in all respects safe, and the CONTRACTOR shall pay all costs of such labor and materials.
- D. The fact that the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, or QAO does not observe a safety hazard or does not order the CONTRACTOR to

take remedial measures shall in no way relieve the CONTRACTOR of the entire responsibility for any costs, loss, or damage by any party sustained on account of the insufficiency of the safety precautions taken by the CONTRACTOR or by the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, or QAO acting under authority of this Section.

- E. It is the responsibility of the CONTRACTOR to take appropriate safety precautions to meet whatever conditions of hazard may be present during the performance of the Work, whether the hazard may or may not be reasonably foreseeable. The CONTRACTOR is alerted to the fact that it shall be his responsibility to anticipate and provide such additional safety precautions, facilities, personnel, and equipment as shall be necessary to protect life and property from whatsoever conditions of hazard are present or may be present.

1.03 RELATED SECTIONS

- A. 00200 – Information Available
- B. 01540 – Job Site Security
- C. 01550 – Site Access and Traffic Control
- D. 01562 – Dust Control
- E. 01563 – VOC, Odor, Vector and Spill Control

1.04 SUBMITTALS

- A. Submit in accordance with Section 01300 of these Technical Specifications.
- B. The CONTRACTOR shall prepare, submit, and implement a HASP, which shall be approved by the GROUP's REPRESENTATIVE and REMEDIAL DESIGNER prior to mobilization onto the Site. The HASP shall conform with all applicable local, state and federal requirements, including, but not limited to, the following:
 - 1. Safety and Health Regulations promulgated by the U.S. Department of Labor: 29 CFR Part 1904 - Recording and Reporting Occupational Injuries and Illness, 29 CFR Part 1910 - Occupational Safety and Health Standards, and 29 CFR Part 1926 - Safety and Health Regulations for Construction.
 - 2. U.S. Environmental Protection Agency Interim Standard Operating Safety Guides - Office of Emergency and Remedial Response - Hazardous Response Support Division, Rev. September 1982.
 - 3. U.S. Environmental Protection Agency Medical Monitoring Program Guidelines.
- C. The HASP shall be prepared by the CONTRACTOR's designated HSO. The HSO shall have experience with establishing and implementing HASPs for

hazardous waste site remediation projects and be a Certified Industrial Hygienist. The resume of the HSO shall be submitted with the CONTRACTOR's HASP for favorable review. The HSO shall be responsible for:

- Preparing and implementing the HASP;
- Updating the HASP, as needed, based on Site conditions;
- Overall health and safety of the CONTRACTOR's and its Subcontractor's personnel;
- Monitoring Site health and safety conditions;
- Protecting surrounding community;
- Coordinating with area residents and other on-site CONTRACTORS and Subcontractors;
- Maintaining all requisite health and safety records; and,
- Identifying, providing, and managing a qualified Site Health and Safety Coordinator who will implement the HASP at the project Site. Resumes of all Site Health and Safety Coordinators shall be submitted with the CONTRACTOR's HASP for favorable review.

D. The CONTRACTOR's HASP shall incorporate the requirements contained herein, and shall describe all actions to be taken to protect the health and safety of workers and the surrounding community. The HASP shall identify all tasks to be undertaken by the CONTRACTOR and shall establish Health and Safety procedures for each task. The CONTRACTOR's HASP shall be prepared by the CONTRACTOR's HSO and be submitted to the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, the USEPA Region II, and NJDEP prior to the initiation of any fieldwork. The GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, the USEPA, and/or NJDEP may comment on the CONTRACTOR's HASP and any modifications thereto, but will not provide approval of the HASP. The CONTRACTOR shall not mobilize to the Site until the CONTRACTOR has been received and addressed review comments on the HASP from the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, USEPA, and NJDEP, unless otherwise indicated by the GROUP's REPRESENTATIVE.

E. Training requirements of all field personnel shall be specified in the HASP. As a minimum, training in accordance with 29 CFR 1910.120 should be required for all personnel involved in the specified remedial construction activities (i.e., all excavation, grading, handling, and disposal of soil and/or waste materials; all in-situ treatment activities; all cap construction activities; all stream bank enhancement activities; and decommissioning and installation of the existing and new groundwater recovery system, respectively) and until all waste material is satisfactorily covered with six (6) inches of clean soil. Such training shall also be required, at a minimum, for all crews who could be exposed to potentially hazardous materials over the entire duration of construction activities.

- F. To assist in preparation of the Health and Safety Plan, the CONTRACTOR is encouraged to review the existing Supplementary Documents in Section 00200, which are available for examination at the REMEDIAL DESIGNER's office.
- G. The HASP shall, at a minimum, include the following:
 - 1. Identification of the HSO and the Remedial Action Site Health and Safety Coordinator(s). HASP shall include resumes for the designated HSO and Site Health and Safety Coordinators;
 - 2. The HASP shall clearly identify and establish locations of all fixed Site perimeter and portable Work-specific air monitoring stations, provide alert/action thresholds for all air monitoring locations, and establish detailed contingency procedures to be implemented by CONTRACTOR, if/when and alert/action threshold levels are exceeded. At a minimum, CONTRACTOR's HASP shall include at least three (3) fixed Site perimeter air-monitoring locations, and two (2) of these perimeter air-monitoring stations shall be positioned on the downwind sides of the Site. CONTRACTOR shall also provide at least one (1) portable air monitoring instrument for each discrete construction activities, as deemed necessary by the HSO or required by the GROUP's REPRESENTATIVE;
 - 3. The HASP shall include provisions for and clearly identify the location for a Site-specific weather station, which shall be capable of monitoring, at a minimum, the following: a) wind speeds and directions; b) atmospheric temperatures; c) barometric pressures; and d) rainfall;
 - 4. Monitoring of the worker's breathing zone, and air upwind and downwind of the work area for organic vapors and respirable dust;
 - 5. Alert/action threshold levels for upgrading personal protective equipment (PPE) or implementing engineering controls shall be determined by the CONTRACTOR and explained in the HASP consistent with assuring health and safety of construction workers and potential on-Site and off-Site receptors, and consistent with all Federal, State, and local rules, regulations, codes, and laws;
 - 6. The Work to be performed at the Site may, on occasion, need to be conducted in Level C or B PPE. The CONTRACTOR shall provide all required PPE for the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, and QAO, and additional on-Site QA personnel, who demonstrate they have the proper updated training for use of such equipment. The CONTRACTOR shall provide decontamination stations and shall maintain the stations daily during the Contract period. The CONTRACTOR shall provide receptacles for and disposal of all PPE used on-Site. PPE may be disposed of in accordance with the requirements for debris and waste soil disposal described in the Contract Documents. Used PPE shall be placed in appropriate containers or drums for off-Site disposal;
 - 7. A requirement that the CONTRACTOR always maintain, at all times, at least one (1) person on-site trained in first aid and CPR;

8. Emergency phone numbers for the local hospital, ambulance service, police, and Fire Company shall be posted in conspicuous locations on-Site. A map showing the location of the nearest hospital and the most direct route to the hospital shall also be posted in conspicuous locations on-site;
9. Names and telephone numbers of emergency contacts for the CONTRACTOR and the GROUP'S REPRESENTATIVE and other designated emergency responders;
10. Contingency Plan describing medical emergency response, fire and explosion response, chemical exposure first aid, unforeseen circumstances, accident and incident reporting and emergency contacts;
11. An evaluation of potential site hazards;
12. Applicable material safety data sheets;
13. A Decontamination Plan, which shall include:
 - a) Description of the procedures and materials used for the decontamination of all equipment that will be in contact with hazardous materials or media containing hazardous materials (i.e., soil, groundwater). Equipment would include such items as drill rigs, trucks, sampling equipment, field instruments, and hand-tools.
 - b) Description and Site map showing the location of a temporary decontamination pad. The decontamination pad shall be constructed to collect all decontamination water for subsequent testing and disposal, and shall be maintained throughout the construction period. Water supply must be provided, transported, and stored by the CONTRACTOR to the decontamination pad location.
 - c) Description of the procedures used to characterize, contain, store, and dispose of wash water and PPE used during decontamination procedures.
14. Listing of local, county, state, and federal agencies and nearby residents that will be contacted in the event an accident occurs that could potentially harm or threaten the health and safety of the CONTRACTOR's personnel, the general public, or the environment.

1.05 SITE BACKGROUND

The Site is located at the intersection of Paterson Plank Road and Gotham Parkway in Carlstadt, Bergen County, New Jersey, and covers an area of about 6-acres. A chemical recycling and waste processing facility, which ceased operation in 1980, formerly occupied the Site. In 1983, the Site was placed on USEPA's National Priorities List (NPL). The Site is bordered to the southwest by Paterson Plank Road, to the northwest by Gotham Parkway, to the southeast by a trucking company, and to the northeast by Peach Island Creek.

Between 1987 and 2006, a number of field investigations and design studies were completed to evaluate soil and groundwater conditions beneath the Site. In broad terms, these investigations have revealed ground conditions comprising fill overlying a clay layer, which is in turn underlain by glacial till and bedrock.

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Between August 1991 and June 1992, construction of an interim remedy for Operable Unit No. 1 (OU-1) was undertaken by the GROUP pursuant to an Administrative Order, dated September 28, 1990, and consisted of the following:

- a) A lateral containment wall comprising a soil-bentonite slurry wall with an integral high-density polyethylene (HDPE) vertical membrane, which circumscribes the property;
- b) A horizontal "infiltration barrier" consisting of high density polyethylene (HDPE) covering the property;
- c) A sheet pile retaining wall along Peach Island Creek;
- d) An extraction system for shallow groundwater consisting of five extraction wells screened in the fill, which discharge to an above grade 10,000 gallon holding tank via an above grade header system; and
- e) A chain link fence circumscribing the Site.

The OU-1 Remedy has been in operation since June 1992, and extracted groundwater is regularly shipped, via tanker trucks, to the DuPont Environmental Treatment (DET) facility, located in Deepwater, New Jersey, for treatment and disposal. Landscaping along the perimeter of the Site adjacent to Paterson Plank Road and Gotham Parkway was added following installation of the Interim Remedy.

On August 26, 2002, USEPA issued a ROD for Operable Unit No. 2 (OU-2), which identified the selected final remedy for the fill materials and shallow groundwater above the clay layer underlying the Site. Subsequently, a Consent Decree was lodged on July 14, 2004, with an effective date of September 30, 2004, which provides for implementation of the OU-2 final remedial action by the Group.

Per the August 26, 2002 ROD, the remedial action objectives for OU-2 are as follows:

- Mitigate direct contact risks and leaching of contaminants from the shallow fill and sludge material into groundwater;
- Reduce toxicity and mobility of the sludge "Hot Spot" contaminants via treatment;
- Provide hydraulic control of the shallow aquifer by maintaining inward groundwater gradients; and
- Perform remediation such that the final remedy may allow for possible, limited (i.e., light commercial) Site re-uses.

The specific remedy elements that were selected in the ROD to achieve these objectives were:

- Installing a cover system over the entire fill area circumscribed by the existing slurry wall, as shown in Figure 3;
- Undertaking stream bank enhancements to provide improved stability, while avoiding adverse impacts to the existing slurry wall and Peach Island Creek;
- Remediating the sludge "Hot Spot" area by in-situ treatment; and
- Upgrading, enhancing and replacing, as necessary, the existing groundwater recovery system to ensure inward groundwater gradients are maintained.

1.06 EMERGENCY RESPONSE/NOTIFICATION OF RELEASES

- A. In the event of any release of petroleum, potentially hazardous materials, or of extremely hazardous substances which may be of immediate threat to humans health and the environment, CONTRACTOR shall immediately inform the GROUP's REPRESENTATIVE and contact the necessary governmental agencies within the required notification deadlines. The CONTRACTOR will submit written reports to GROUP REPRESENTATIVE within two (2) business days following said releases, and these reports shall describe the events that occurred and the measures taken or to be taken to mitigate the release or threatened endangerment and to prevent the reoccurrence of such a release. The reporting requirements under Section 103(c) of CERCLA, 42 U.S.C. §9603(c), the Section 304 of the Emergency Planning and Community Right-To-Know Act of 1986 42 U.S.C. §11004 and any reporting requirements under the Consent Decree shall be followed. Provisions for these notifications and response to release shall be addressed in the CONTRACTOR's Health and Safety Plan.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 RECORDKEEPING

- A. All parties engaged in on-site activities shall read the CONTRACTOR's HASP for the relevant tasks. The CONTRACTOR shall maintain on-Site documentation demonstrating compliance with this requirement. Written evidence of compliance with 29 CFR 1910.120 and applicable State and Federal requirements, for all parties engaged in on-Site activities, shall be maintained on-Site in the CONTRACTOR's files. Copies of such documentation shall be provided to the GROUP's REPRESENTATIVE or the QAO upon request.

*****END OF SECTION*****

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ATTACHMENT TO SPECIFICATION SECTION 01564

**GENERAL OUTLINE FOR
CONTRACTOR'S HEALTH AND SAFETY PLAN**

**PRELIMINARY OUTLINE FOR PROJECT SPECIFIC
CONTRACTOR HEALTH AND SAFETY PLANS**

- I. Introduction
- II. Health and Safety Personnel and Responsibilities
- III. Work Area Designations and Access
- IV. Project Specific Hazards and Controls
- V. Environmental Hazards and Controls (e.g. Weather, Poison Ivy, slips, falls, etc.)
- VI. Personal Protective Clothing
- VII. Monitoring
- VIII. Action Levels
- IX. Employee Training
- X. Medical Surveillance
- XI. Emergency Procedures
- XII. Contamination Control
- XIII. Documentation

SECTION 01580

WARNING SIGNS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Furnish and install signs at the locations as determined by the Remedial Designer.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. Each sign shall be non-reflective minimum 18-gauge steel or 0.080-inch thick aluminum and shall have a white background with black lettering and borders.
- B. The signs shall include the following information:

NOTICE
216 Paterson Plank Road Superfund Site
No Trespassing
CONTRACTOR name
Project is being performed under EPA oversight
For information call the USEPA at (###-###-####)

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Signs shall be attached to the new security fence at the main entrance located on the Paterson Plank Road side of the Site. Each sign shall be bolted at all corners to a blank sign constructed of the same material placed on the opposite side of the fence.
- B. After favorable review of the sign installation by Remedial Designer, peen ends of bolts or score threads to prevent removal of nuts.

*****END OF SECTION*****

SECTION 01590

FIELD OFFICE AND STORAGE AREAS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall provide a field office (i.e., trailer) for the CONTRACTOR's own needs and a separate GROUP Field Office for the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, QAO, and USEPA/NJDEP representatives. The CONTRACTOR shall also provide secure storage space for the CONTRACTOR's needs.
- B. The size of the CONTRACTOR's field offices and capacity of the storage areas shall be the responsibility of the CONTRACTOR, and shall be such that daily operations can be conducted without restrictions. The field office space shall provide adequate space for project meetings. Storage areas shall allow for access and orderly provision for maintenance and for inspection of products. The locations of the CONTRACTOR's administrative, staging, and laydown areas shall be coordinated in the field with the GROUP's REPRESENTATIVE.
- C. The CONTRACTOR shall be responsible for all costs to permit, install, maintain/service, and remove all temporary utilities for the duration of the project, including normal costs associated with electricity, telephone, facsimile machine, water, sewer, equipment maintenance, and maintenance service.
- D. Within ten (10) working days after the commencement date indicated in the written Notice to Proceed, the CONTRACTOR shall install the field office provided for the use of the GROUP's REPRESENTATIVE in connection with performance of the Work, unless another time period is acceptable to the GROUP.
- E. If CONTRACTOR concludes there is not adequate room on-site for the above noted field offices and its material storage and lay-down areas, CONTRACTOR shall propose alternate off-site, within immediate (i.e., about 1-mile-radius) vicinity of the Site, options for these field offices and/or storage areas. These alternate options shall be incorporated into CONTRACTOR's comprehensive construction work plan, and submitted to the GROUP's REPRESENTATIVE for review and approval.
- F. CONTRACTOR may propose to utilize the existing on-site field trailer, which will be removed by CONTRACTOR as part of this Contract, as its designated field offices. Improvement deemed necessary by CONTRACTOR to this existing trailer shall be at the CONTRACTOR's cost, and the GROUP will not reimburse CONTRACTOR for these improvements.

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PART 2 – PRODUCTS

2.01 MATERIALS

- A. All equipment, building materials, furnishings, and fixtures must be adequate for the required purposes.
- B. The GROUP'S Field Office shall have a locking entrance door with a new lock and ten (10) keys (min.), and shall include at a minimum one (1) office and one (1) meeting room.
- C. Office Furnishings/Equipment for the CONTRACTOR's and GROUP's Field Offices shall include:
 - 1. Minimum of three (3) standard size desks, 3 feet by 5 feet with drawers with locks and keys.
 - 2. One (1) 30-inch by 72-inch drafting table.
 - 3. One (1) standard conference table with ten (10) chairs.
 - 4. Dry type copy machine capable of making 8-1/2 by 11-inch, and 11 by 17-inch copies without reductions. Provide all supplies, expendables, and maintenance for period field offices are required.
 - 5. Dry type plain paper fax machine, including all supplies, expendables, and maintenance for the period the field office is required.
 - 6. Packaged, new basic first aid kit.
 - 7. Two (2), 5-lb. nominal capacity, wall mounted fire extinguishers, including one UL-rated for use on electronic equipment.
 - 8. Minimum of four (4) 110-volt duplex convenience outlets, at least one (1) on each wall and one (1) in each desk area.
 - 9. One (1) telephone capable of recording messages.
 - 10. One (1) data transmission line capable of sending/receiving facsimiles.
 - 11. One (1) high-speed (i.e., Digital Subscriber Line (DSL) or Cable Modem) internet connection capable of providing a minimum data transmission rate of 1.5 MB/sec.
 - 12. One (1) potable water supply.
 - 13. One (1) five (5) c.f. (min.) refrigerator.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Field offices shall be placed at a staging area designated by the CONTRACTOR, or as otherwise approved by the GROUP's REPRESENTATIVE.
- B. Prior to the placement or construction of the field offices, the areas shall be graded and covered with a layer of coarse aggregate, as necessary, to promote surface drainage away from the field offices in a manner approved by the GROUP'S REPRESENTATIVE.

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3.02 INSTALLATION

- A. The field office shall be installed on an adequate foundation and shall be level. Portable trailers shall be adequately anchored to prevent uplift in accordance with the supplier's recommendation or local building codes.
- B. Office space shall be ready for occupancy no later than ten (10) days after the commencement date in the Notice to Proceed.
- C. Parking areas shall be located adjacent to the field office. If CONTRACTOR believes there is not adequate room on-Site for parking, CONTRACTOR shall propose alternate off-Site locations for its designated parking areas.

3.03 CONSTRUCTION

- A. Portable or mobile buildings with raised floors shall be equipped with steps and landings at entrance doors including steps and handrails constructed in accordance with applicable Federal, State and local regulations.
- B. The offices shall be of sound construction, weather-tight, and equipped with climate-control units (heat and air conditioning).
- C. Temperature transmission resistance of the office walls, ceiling, floors, and roof shall be compatible with occupancy and storage requirements.
- D. The exterior materials shall be weather-resistant and acceptable to the GROUP'S REPRESENTATIVE.
- E. The offices shall have adequate interior lighting and exterior lighting at the entrances and within the parking area.
- F. Each door shall be equipped with a new locking device. Provide four (4) sets of keys to each lock.

3.04 CONTRACTOR OFFICE AND FACILITIES

- A. The CONTRACTOR's office shall be large enough for the CONTRACTOR's needs, and shall provide adequate space for project meetings.
- B. A meeting area shall be furnished with a table and chairs to seat at least ten (10) people.

3.05 STORAGE AREAS AND SHEDS

- A. Size storage areas based on requirements of products to be stored. Allow for access and orderly provision for maintenance and for inspection of products.

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3.06 SERVICES

- A. Power: Each office shall be supplied with electrical power provided in accordance with the local codes. CONTRACTOR shall coordinate with local utility companies to furnish electric power to the GROUP'S REPRESENTATIVE's field trailer.
- B. Telephone: Each office shall be supplied with telephone service provided in accordance with the local codes. CONTRACTOR shall coordinate with local utility companies to furnish two separate telephone lines to GROUP'S REPRESENTATIVE's field trailer.
- C. Drinking Water: Each office shall be supplied with potable drinking water, which may consist of bottled water (with a dispenser), which is capable of heating or chilling the water, and have a continuous supply of paper cups.
- D. Clean Water Supply: The CONTRACTOR shall supply clean water for use in cleaning equipment and decontamination. This water shall be available for use by the GROUP'S REPRESENTATIVE.
- E. Sanitary Facilities:
 - 1. CONTRACTOR shall supply a minimum of three (3) portable toilets adjacent to the office trailers and shall be responsible for maintaining these on a weekly basis (or more frequently, as required) while personnel are on-Site.
- F. Provide safe approach, entry, and exit. Stockpiles, debris, and equipment shall be located away from the field office.

3.07 REMOVAL

- A. At completion of Work, remove buildings, utility services, trailers, and debris as directed by the GROUP'S REPRESENTATIVE. Restore areas in accordance with instructions from the GROUP's REPRESENTATIVE.

END OF SECTION

SECTION 01666

CLEANING AND TESTING OF PIPING

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. Furnish all labor, materials, tools, equipment and appurtenances required for the cleaning and testing of piping for the enhanced groundwater extraction system installed by the CONTRACTOR, as specified herein and in other Sections of these Technical Specifications.

1.03 SUBMITTALS

- A. Submittals shall include proposed testing procedures, including test medium and pressure, line segments and equipment included in the test, methods of isolating sections of the system, pressure monitoring techniques, and the certification form to be submitted to the GROUP'S REPRESENTATIVE.
- B. Submit in accordance with Section 01300 of these Technical Specifications.

1.04 RELATED SECTIONS

- A. 01400 – Quality Control
- B. 02612 – Reinforced Concrete Culvert Pipe
- C. 02613 – Corrugated Metal Pipe
- D. 02614 – Corrugated Polyethylene Pipe
- E. 02615 – High Density Polyethylene Pipe
- F. 02650 – Polyethylene Pipe, Flow Totalizers, and Plastic Valves
- G. 02675 – Piezometers and Monitoring Wells
- H. 13208 – Leachate Holding Tank

PART 2 – PRODUCTS

2.01 GENERAL

- A. Detergents, solvents, and other cleaning or testing materials shall be compatible with the materials of fabrication of the systems in which they are used. They shall not adversely affect the materials or mechanisms in the systems, and they shall be acceptable to equipment manufacturers/vendors. Detergents, solvents, and other cleaning agents shall also be non-flammable and compatible with the process streams to be handled by the systems in which they are used and shall not contain any chlorinated solvents.
- B. Materials including blinds, gaskets, bolts, flanges, caps, gauges, and other equipment used in isolating segments of systems shall be compatible with the systems being cleaned or tested.

2.02 TEST MEDIUMS

- A. The CONTRACTOR shall furnish all equipment, necessary piping, required labor and expenses to test piping systems. Test medium shall be as specified herein.

2.03 TEST EQUIPMENT

- A. The CONTRACTOR shall furnish all labor and equipment, including required pumps, vacuum pumps and compressors with regulated bypass meters, valves, blind flanges, plugs, chart recorders, and gauges, for conducting of the piping tests. Gauges and chart recorders shall be calibrated to a National Bureau of Standards traced standard. Gauges and chart recorders shall have divisions not exceeding two (2) percent of the test pressure.

PART 3 – EXECUTION

3.01 CLEANING

- A. The CONTRACTOR shall provide and install temporary connections, strainers, and other equipment to thoroughly clean the piping systems before start-up. Cleaning shall include a thorough rinsing with water to remove sediments of pipe material shavings and other debris. The GROUP'S REPRESENTATIVE and QAO shall visually observe a clean piping system free of shavings and/or other debris prior to start-up. The CONTRACTOR shall collect and dispose of cleaning agents in accordance with Section 02402 of these Technical Specifications and shall remove all temporary connections and strainers after cleaning is complete.
- B. Piping shall be cleaned just prior to installation and again prior to start-up. Cleaned piping material shall be protected against contamination by sealing open ends with clear plastic sheets, metal foil, or other approved materials.

3.02 TESTING

- A. Upon completion of piping installation, but prior to covering concealing or burying piping, test all newly installed enhanced groundwater extraction piping systems.
- B. The timing and sequence of testing shall be scheduled by the CONTRACTOR, subject to the favorable review by the GROUP'S REPRESENTATIVE and QUALITY ASSURANCE OFFICER (QAO). The CONTRACTOR shall provide the GROUP'S REPRESENTATIVE and QAO two (2) working days notice prior to all testing.
- C. Utilize vacuums, media, and test duration as specified herein.
- D. Isolate equipment, which may be damaged by the specified test conditions.

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- E. Perform vacuum / pressure tests using calibrated pressure gauges. Select each gauge so that the specified test vacuum falls within the upper half of the gauge's range.
- F. Unless otherwise specified, completely assemble and test new piping systems prior to connection to existing piping systems.
- G. All piping (in a completed system) shall be vacuum / pressure tested to 1.5 times the maximum pressure / vacuum that can be applied by the blower / compressor / pumps in place, in the presence of the GROUP'S REPRESENTATIVE and QAO, for a period of one (1) hour with no noticeable loss of pressure / vacuum.
- H. No pipe installation will be accepted should there be evidence of exterior surface damage to the pipe that, in the option of the GROUP'S REPRESENTATIVE or QAO, may compromise the integrity of the piping system, even though it may pass the testing requirements
- I. All tests shall be made before piping is covered or otherwise concealed. The CONTRACTOR, at the CONTRACTOR's own expense, shall uncover and retest any piping not satisfactorily tested in the presence of the GROUP'S REPRESENTATIVE and QAO. Testing shall be conducted after laying or modifying of the piping systems and prior to backfilling and then repeated after final grading.
- J. The testing requirements for the respective systems shall include all applicable federal, state and local laws, rules, and/or regulations. All code-required inspection certificates shall be furnished to the GROUP'S REPRESENTATIVE and QAO.
- K. The CONTRACTOR shall collect and dispose of liquids used for testing in accordance with Section 02402 of these Technical Specifications.

3.03 PIPE TEST SCHEDULE

- A. Upon completion of each piping system or sub-system, clean and test the lines. All piping shall be tested after completion of a section or subsection prior to backfilling of trench.
- B. Repair and retest any piping system found to be leaking until results are satisfactory to the GROUP'S REPRESENTATIVE and QAO.

3.04 REPAIRS

- A. The point, or points, of leakage shall be sought out and remedied by the CONTRACTOR at the CONTRACTOR's expense.
- B. All repairs will be observed by the GROUP'S REPRESENTATIVE and QAO.
- C. Repair methods must be satisfactory to the GROUP'S REPRESENTATIVE and QAO.

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3.05 FINAL ACCEPTANCE

- A. No pipeline installation or pumping well will be accepted until all leaks have been repaired. All repairs will be observed by the GROUP'S REPRESENTATIVE and QAO.
- B. The CONTRACTOR shall provide the GROUP'S REPRESENTATIVE and QAO with written certification and test charts clearly identifying location of pipe being tested of equipment/system cleaning and testing in accordance with this Section. All test data and documentation shall be provided to the GROUP'S REPRESENTATIVE as part of the written certification.

*****END OF SECTION*****

SECTION 01700

CONTRACT CLOSEOUT

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The work under this section includes, but is not limited to, the maintenance, recording and submittal of appropriate project documents for project closeout. CONTRACTOR shall provide a Competent Person to implement, supervise, and inspect all Work.

1.02 RELATED SECTIONS

- A. 01300 – Submittals
- B. 01380 – Construction Photographs and Videos
- C. 01720 – Record Documents
- D. 01740 – Warranties

1.03 SUBSTANTIAL COMPLETION

- A. CONTRACTOR shall submit written notice to the GROUP'S REPRESENTATIVE that the Work, or designated portion of the Work, is substantially complete in accordance with the General Conditions.
- B. CONTRACTOR shall submit a list of major items to be completed or corrected.
- C. The GROUP'S REPRESENTATIVE will review the Work after receipt of notice, together with CONTRACTOR.
- D. Should the GROUP'S REPRESENTATIVE consider the Work tentatively substantially complete:
 - 1. CONTRACTOR shall prepare and submit to the GROUP'S REPRESENTATIVE, a list of items to be completed or corrected, as determined by the review.
 - 2. CONTRACTOR shall complete aspects of the Work listed for completion or correction, within designated time.
- E. Should the GROUP'S REPRESENTATIVE consider the Work not substantially complete:
 - 1. The GROUP'S REPRESENTATIVE shall notify CONTRACTOR within two (2) working days, in writing, stating the reasons why the Work is not considered substantially complete.
 - 2. CONTRACTOR shall complete the Work, and send second written notice to the GROUP'S REPRESENTATIVE, certifying that the Work, or designated portion of the Work, is substantially complete.
 - 3. The GROUP'S REPRESENTATIVE will then again review the Work.

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1.04 FINAL CLEANING

- A. Execute final cleaning prior to the final inspection.
- B. Clean any debris from the Work areas.
- C. Clean the remainder of the Site of any deleterious material as directed by the GROUP'S REPRESENTATIVE.
- D. Remove waste and surplus materials, rubbish, and construction facilities and offices from the Site.
- E. Restore all disturbed areas to "as-was" or "better" conditions to the satisfaction of the GROUP'S REPRESENTATIVE.

1.05 FINAL REVIEW

- A. The CONTRACTOR shall submit written certification that:
 - 1. The Work has been completed in accordance with the Contract Documents.
 - 2. All inspections by local or regional agencies have been satisfactorily completed.
 - 3. The Work is complete and ready for final review.
 - 4. The Project Record Documents have been maintained in accordance with Sections 01300 and 01720 of these Technical Specifications and accurately describe the completed Work.
- B. The GROUP'S REPRESENTATIVE shall verify the information contained in Article 1.05-A for accuracy.
- C. Should the GROUP'S REPRESENTATIVE consider the Work not finally complete:
 - 1. The GROUP'S REPRESENTATIVE shall notify the CONTRACTOR within two (2) working days, in writing, stating the reasons why the Work is not considered finally complete.
 - 2. The CONTRACTOR shall take immediate steps to remedy the stated deficiencies and send second written notice to GROUP'S REPRESENTATIVE certifying that the Work is complete.
 - 3. The GROUP'S REPRESENTATIVE will then again review the Work.

1.06 CLOSEOUT SUBMITTALS

CONTRACTOR shall submit to the GROUP'S REPRESENTATIVE for review and acceptance:

- A. Deliver evidence of compliance with requirements of governing authorities:
 - 1. Certificates of Acceptance, if required.
 - 2. Certificate of Occupancy, if required.

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- B. Deliver Certificate of Insurance for Products and Completed Operations.
- C. Applicable requirements of Federal, State, and local agencies having jurisdiction.
- D. Written warranties and/or guaranties from manufacturers for components, materials, and equipment which constitute the Work.
- E. Project Record Documents in accordance with Section 01300 and 01720 of these Technical Specifications within thirty (30) days of substantial completion.

1.07 EVIDENCE OF PAYMENTS AND RELEASE OF LIENS

- A. CONTRACTOR's Affidavit of Payment of Debts and Claims.
- B. CONTRACTOR's Affidavit of Release of Liens; with:
 - 1. Consent of Surety to Final Payment.
 - 2. CONTRACTOR's release or waiver of liens (to be reviewed by the GROUP'S REPRESENTATIVE prior to final Payment Certification).
 - 3. Separate releases or waivers of liens for subcontractors, suppliers, and others with lien rights against property of GROUP, together with list of those parties.
- C. All submittals shall be duly executed before delivery to the GROUP'S REPRESENTATIVE.

1.08 FINAL ADJUSTMENT OF ACCOUNTS

- A. Submit the final Application for Payment to the GROUP'S REPRESENTATIVE for verification and acceptance of the information provided. The GROUP'S REPRESENTATIVE will submit the Application for Payment to the GROUP for review, acceptance, and payment.
- B. Application for Payment shall reflect all adjustments, including:
 - 1. Original Contract Price.
 - 2. Additions and deductions resulting from:
 - a. Previous Change Orders;
 - b. Unit Prices;
 - c. Other adjustments;
 - d. Deductions for uncorrected work; and,
 - e. Deductions for Re-review/Re-inspect payments.
 - 3. Total Contract Price, as adjusted.
 - 4. Previous payments.
 - 5. Amount remaining due.

1.09 POST-CONSTRUCTION REVIEW

- A. Prior to expiration of one (1) year from the Date of Substantial Completion, the GROUP'S REPRESENTATIVE will make visual review of the Work, in the

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company of the CONTRACTOR, to determine whether correction of the Work is required. CONTRACTOR shall correct the deficiencies in a timely manner, in accordance with Section 01740 of these Technical Specifications.

- B. The GROUP'S REPRESENTATIVE will promptly notify CONTRACTOR, in writing, of any observed deficiencies.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

*****END OF SECTION*****

SECTION 01720

RECORD DOCUMENTS

PART I – GENERAL

1.01 DESCRIPTION OF WORK

- A. The Work under this Section includes, but is not necessarily limited to, the maintenance, recording, and submittal of Record Documents as herein specified.
- B. CONTRACTOR shall maintain, in designated locations at the Site for the GROUP's REPRESENTATIVE, at least one (1) record copy of each of the following items as Record Documents:
 - 1. Contract Drawings and associated Addenda;
 - 2. Contract Technical Specifications and associated Addenda;
 - 3. Change Orders and other approved/authorized modifications to the Contract;
 - 4. The GROUP's REPRESENTATIVE and/or QUALITY ASSURANCE OFFICER's (QAO) Field Orders or written instructions;
 - 5. Reviewed construction submittals including, but not limited to, Shop Drawings, product data, samples, and manufacturer's certifications;
 - 6. Field quality assurance and quality control (QA/QC) test records;
 - 7. Monthly Construction Photographic Reports; and
 - 8. Daily work activity reports, including:
 - a. Field QA/QC test records,
 - b. Construction photographs and videos,
 - c. Reports on emergency response actions,
 - d. Records of all Site work,
 - e. Chain-of-custody documents,
 - f. Laboratory test records,
 - g. Meteorological records,
 - h. Daily inspection records,
 - i. Reports on all safety and accident incidents,
 - j. Reports on all spill incidents,
 - k. Air monitoring reports and data,
 - l. Manifest documents, truckload tickets, and shipping papers,
 - m. Security records,
 - n. Other items that may be required by the GROUP's REPRESENTATIVE and/or QAO, and
 - o. Log of control and survey work.
- C. Other Documents: All QA/QC records/documents not identified above, but required by the individual Sections of these Technical Specifications.
- D. The GROUP's REPRESENTATIVE and QAO shall verify the Items listed in Article 1.01 (Parts A, B, and C herein) for accuracy during the course of the Work.

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1.02 RELATED SECTIONS

- A. 01300 – Submittals
- B. 01380 – Construction Photographs and Videos
- C. 01700 – Contract Closeout

1.03 MAINTENANCE OF RECORD DOCUMENTS

- A. Storage
 - 1. Store documents in CONTRACTOR's field office apart from documents used for construction.
 - 2. Provide files and racks for storage of documents.
 - 3. Provide locked cabinet or secure storage space for storage of samples.
- B. File documents in accordance with the format of these Technical Specifications.
- C. Maintenance
 - 1. Maintain documents in a clean, dry, legible condition, and in good order.
 - 2. Do not use the Record Documents for construction purposes.
- D. Make documents and samples available at all times for inspection by the GROUP's REPRESENTATIVE, QAO, and the REMEDIAL DESIGNER.

1.04 RECORDING

- A. Label each document "Project Record" in neat, large-printed letters.
- B. Recording:
 - 1. Record information concurrently with construction progress.
 - 2. Do not conceal any work until required information is recorded.
- C. Drawings: Record Drawings shall have a title block indicating that the drawings are Record Drawings, the name of the company preparing the Record Drawings, and the date the Record Drawings were prepared. Legibly mark drawings to record actual construction:
 - 1. Field changes of dimension and detail.
 - 2. Changes made by request for clarification of the Contract Documents, Field Order, or by Change Order.
 - 3. Details not on the original Contract Drawings.
 - 4. Horizontal and vertical locations of underground utilities and appurtenances.
- D. Specifications: Legibly mark each Section to record:
 - 1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
 - 2. Changes made by request for clarification of the Contract Documents, Field Order, or by Change Order.

- E. Additional Record Documents shall be prepared as required by individual Sections of these Technical Specifications or the Contract Documents.

1.05 SUBMITTALS

- A. At Contract closeout, CONTRACTOR shall prepare and deliver ten (10) complete sets and one (1) electronic copy (i.e., PDF file format) of the Record Documents to the GROUP's REPRESENTATIVE and QAO for review.

Record Drawings shall be certified and stamped by a Professional Engineer licensed in the State of New Jersey. Survey data and plans shall be certified by a Professional Land Surveyor licensed in the State of New Jersey.

Each Final Construction Report shall include a Final Construction Photographic Report, consisting of a compilation of the individual monthly reports, prepared in accordance with Section 01380 of these Technical Specifications. Photographic negatives shall be mounted, as necessary, in clear plastic, loose-leaf, negative mounts, bound in a separate binder which includes copies of the photographic logs as described in Section 01380 of these Specifications, and submitted to the REMEDIAL DESIGNER. If CONTRACTOR collects photographs using digital cameras, CONTRACTOR shall not use cameras with resolutions less than four (4) mega-pixels. In addition, CONTRACTOR shall provide hard copy prints for each photograph, and copies of all associated electronic files (i.e., TIFF and/or JPEG) shall be delivered to the GROUP's REPRESENTATIVE.

- B. Accompany the submittal with transmittal letter, in duplicate, containing:

1. Date;
2. Project title and number;
3. The CONTRACTOR's name, address, and telephone number;
4. Title and number of each record document; and
5. Signature of the CONTRACTOR's authorized representative.

- C. Submit in accordance with Section 01300 of these Technical Specifications.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

*****END OF SECTION*****

SECTION 01740

WARRANTIES

PART 1 – GENERAL

1.01 Project Maintenance and Warranty

- A. Maintain and keep in good repair the Work covered by these Drawings and Specifications until acceptance by the GROUP'S REPRESENTATIVE.
- B. CONTRACTOR shall warrant for a period of one (1) year from the date of the GROUP'S written acceptance of certain segments of the Work and/or the GROUP'S written final acceptance of the Project, as defined in the Contract Documents, that the completed Work is free from all defects due to faulty products or workmanship and CONTRACTOR shall promptly make such corrections as may be necessary by reason of such defects. The GROUP will give notice of observed defects with reasonable promptness. In the event that CONTRACTOR should fail to make such repairs, adjustments or other work that may be made necessary by such defects, the GROUP may do so and charge CONTRACTOR the cost thereby incurred.
- C. CONTRACTOR shall not be obligated to make replacements which become necessary because of ordinary wear and tear, or as a result of improper operation or maintenance, or as a result of improper work or damage by another CONTRACTOR or the GROUP, or to perform any work which is normally performed by a maintenance crew during operation.
- D. In the event of multiple failures of major consequences prior to the expiration of the one (1) year warranty described above, the affected item shall be disassembled, inspected and repaired or modified, as necessary, to prevent further failures. All related components, which may have been damaged or rendered non-serviceable as a consequence of the failure, shall be replaced. A new twelve (12) month warranty against defective or deficient design, workmanship, and materials shall commence on the day that the item is reassembled and placed back into operation. As used herein, multiple failures shall be interpreted to mean two (2) or more successive failures of the same kind in the same item or failures of the same kind in two (2) or more items. Failures that are directly and clearly traceable to operator abuse, such as operations in conflict with operating procedures or improper maintenance, such as substitution of unauthorized replacement parts, use of incorrect materials, and using maintenance procedures not conforming with published maintenance instructions, shall be exempted from the scope of the one year warranty. Should multiple failures occur in a given item, all products of the same size and type shall be disassembled, inspected, modified or replaced as necessary and re-warranted for one (1) year.
- E. CONTRACTOR shall, at CONTRACTOR's own expense, furnish all labor, materials, tools and equipment required and shall make such repairs and removals and shall perform such work or reconstruction as may be made necessary by any structural or functional defect or failure resulting from neglect,

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faulty workmanship or faulty materials, in any part of the Work performed by the CONTRACTOR.

- F. Except as noted on the Construction Drawings or as specified, all existing structures not designated for removal shall be returned to their original condition prior to the completion of the Contract. CONTRACTOR, at no cost to the GROUP, shall promptly repair any and all damage to any existing facility not designated for removal, which are a direct result of CONTRACTOR's construction operations.
- G. CONTRACTOR shall be responsible for all road and entrance reconstruction and repairs and maintenance for a period of one (1) year from the date of final acceptance. In the event the repairs and maintenance are not made immediately and it becomes necessary for the GROUP of the road to make such repairs, CONTRACTOR shall reimburse the GROUP for the cost of such repairs.
- H. The GROUP'S REPRESENTATIVE and the QUALITY ASSURANCE OFFICER (QAO) shall have access to the Work at all times, and CONTRACTOR shall provide such access for their inspection and/or observation. Examination or re-examination of covered Work may be ordered by the GROUP'S REPRESENTATIVE and/or QAO, and, if so ordered, such Work must be uncovered by the CONTRACTOR.
- I. In the event CONTRACTOR fails to proceed to remedy the defects upon notification within fifteen (15) days of the date of such notice, the GROUP reserves the right to cause the required materials to be procured and the work to be done, as described in the Construction Drawings and Technical Specifications, and to hold CONTRACTOR liable for the cost and expense thereof.
- J. Notice to CONTRACTOR for repairs and reconstruction will be made in the form of a registered letter per the notice provisions of the contracts.
- K. Neither the foregoing paragraphs nor any provision in the Contract Documents, nor any special guarantee time limit implies any limitation of CONTRACTOR's liability within the law of the place of construction.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

Not Used

END OF SECTION

SECTION 02060

DEMOLITION

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall furnish all labor, equipment, materials, tools, and appurtenances, and perform all operations necessary to complete the required demolition activities, as indicated on the Contract Drawings and as specified herein.
- B. The Work of this Section includes, but is not limited to, the following:
 - a. Removal of the existing office trailer;
 - b. Relocation and/or capping of existing utilities, as necessary;
 - c. Removal of designated portions of the existing perimeter Site fences;
 - d. Abatement of regulated items and materials;
 - e. Demolition of existing structures designated for removal;
 - f. Decommissioning of the existing groundwater extraction system and related appurtenances including, but not limited to, the existing aboveground storage tank, discharge piping, control systems, selected piezometers, and existing extraction wells;
 - g. Empty existing drums, which reside on-Site and contain soil and drill cutting materials collected during previous on- and off-Site subsurface investigations, utilize these soil materials as grading fill beneath the new cap, in accordance with Section 02221 of the Technical specifications, and crush the empty drums and dispose off-Site;
 - h. Excavation and Site grading directly associated with the specified demolition activities, as necessary;
 - i. Handling and relocation of waste materials to designated areas, as necessary;
 - j. Disposal of solid and liquid waste materials off-Site, as necessary; and
 - k. Other related and/or incidental work associated with the required demolition activities, as indicated on the Contract Documents and as specified herein.
- C. The CONTRACTOR shall provide a “Competent Person” to implement, supervise, and inspect the Work.
- D. The CONTRACTOR shall locate all existing active and abandoned utilities and structures to remain in-place within designated Work areas, prior to commencing any demolition activities. The CONTRACTOR shall also protect from damage

those utilities and structures, which are designated to remain in-place, as necessary.

- E. The CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations and laws of local, State, or Federal authorities having jurisdiction. Comply with Sections 02221 and 02402 of these Technical Specifications for the excavation, removal, handling, and disposal of solid and liquid wastes generated during any demolition work, as applicable and necessary.

1.02 RELATED SECTIONS

- A. 01050 – Field Engineering/Surveying
- B. 01562 – Dust Control
- C. 01563 – VOC, Odor, Vector and spill Control
- D. 01564 – Health and Safety
- E. 02070 – Well Decommissioning
- F. 02100 – Site Preparation
- G. 02125 – Erosion and Sediment Control
- H. 02210 – Site Grading
- I. 02220 – Excavation
- J. 02221 – Soil and Waste Disposal
- K. 02223 – Backfill and Fill
- L. 02402 – Liquids Handling and Disposal

1.03 REGULATORY REQUIREMENTS

- A. Comply with applicable Federal, State and local Occupational Safety and Health regulations and environmental statutes.
- B. Comply with applicable State regulations and codes, and any municipal requirements.
- C. Comply with requirements of applicable Federal regulations that may prevail over State regulations listed above, including: Title 40, Code of Federal Regulations, Parts 261, 262, 264, 265, and 268.
- D. Conform to applicable codes for demolition, safety, dust control, service utilities and materials handling.

1.04 SUBMITTALS

- A. Demolition Work Plan: Prior to commencement of demolition activities on-Site, the CONTRACTOR shall prepare and submit, to the GROUP's REPRESENTATIVE, a detailed, comprehensive demolition work plan, which includes, but not limited to, the following:

1. CONTRACTOR and/or SUBCONTRACTOR Qualifications;
 2. Description of the CONTRACTOR's construction methodology, means-and-methods, sequences of construction, and equipment to be used for these demolition activities;
 3. Shop drawings showing the locations of all existing building structures, utilities, fences, and other Site features, which are designated for removal. In addition, these drawings shall indicate the locations of the existing groundwater extraction system, which are designated for removal.
 4. Material storage and lay-down areas, as necessary; and
 5. Copies of all required permits and/or certifications required to complete the Work, as defined herein.
- B. As-Built Drawings: The CONTRACTOR shall prepare and submit "As-Built" drawings showing the locations and depths of Site infrastructures demolished and/or removed, as part of this Work. This plan shall also include surveyed coordinates of the remaining structures and capped utilities relative to permanent on-Site or off-Site benchmarks.
- C. Waste Disposal Documentation: The CONTRACTOR shall submit copies of all associated soil and/or liquid waste disposal forms for all waste materials generated on-Site and disposed of off-Site, in accordance with Section 02221 of these Technical Specifications.
- D. Submit in accordance with Section 01300 of these Technical Specifications.

1.05 ENVIRONMENTAL DECOMMISSIONING

- A. Removal, handling, characterization, transportation, and disposal of any and all regulated materials present within the existing building structures and groundwater extraction system, which are designated for demolition and removal, as shown on the Contract Drawings and as specified herein. This includes, but is not limited to, the following items:
- a. Asbestos containing materials;
 - b. Batteries (lead acid, NiCd, etc.);
 - c. Oil-containing electrical equipment;
 - d. Fluorescent and other high intensity lighting, and related PCB-containing ballasts and capacitors;
 - e. Equipment oil;
 - f. Refrigerants in process and non-essential equipment;
 - g. Piping;
 - h. Above ground storage tank and associated materials;
 - i. Environmental samples;
 - j. Mercury containing devices (if any);
 - k. Miscellaneous chemical containers;

- I. Other regulated waste materials.
- B. Removal and proper management of residuals contained in the existing groundwater extraction system (i.e., pumping wells, discharge lines, and storage tank). Residuals may include water, sediments, sludge, and other related media. This includes removal, characterization, handling, transportation, and disposal of residual waste materials and rinse water within these structures. Under no circumstance shall residuals be discharged to the Peach Island Creek, to the ground, to storm sewer inlets, and/or to sanitary sewer lines.
- C. Decommissioning of the existing aboveground groundwater extraction system piping systems, including draining and proper management of residual fluids and solids (where appropriate).
- D. Cleaning of interior surfaces, such as walls and floors, where designated and as necessary to comply with Federal, State and/or local requirements. Certain areas to be cleaned may be environmentally impacted and should be properly decontaminated. Residuals associated with the decontamination efforts (i.e., wash water, solvents, and solid wastes) shall be properly managed and disposed of off-Site, in accordance with Section 02221 of these Technical Specifications

1.06 UTILITY CUTTING AND CAPPING

- A. The CONTRACTOR shall locate all existing active and abandoned utilities and perform the cutting and capping of designated underground and aboveground utilities to the satisfaction of the GROUP's REPRESENTATIVE and REMEDIAL DESIGNER. Capping of utilities shall be performed in accordance with local ordinances, utility requirement, or other requirements, or in the absence of thereof, in accordance with typical industry standards.

1.07 SITE RESTORATION

- A. Upon completion of demolition activities, the CONTRACTOR shall infill all ground surface depressions created, as direct results of the specified demolition activities. Said depressions shall be backfill with approved fill materials, as necessary to establish pre-demolition grades or to levels designated by the REMEDIAL DESIGNER. All backfill shall meet size and compaction requirements, as noted in Section 02223 of these Technical Specifications.
- B. Following backfill efforts, the property shall be graded to allow adequate stormwater drainage in accordance with pre-approved plans for grading and erosion control submitted by the CONTRACTOR as part of the DEMOLITION PLAN. Sedimentation and erosion controls are to be installed and maintained, and shown on the Contract Drawings and Section 02125 of these Technical Specifications.

1.08 PROTECTION OF PEOPLE AND PROPERTY

- A. The CONTRACTOR shall plan and conduct its demolition operations and take all necessary precautions to prevent damage to existing utilities, structures, roads, grades, slopes, surface water drainage features, underground piping, manholes, monitoring/pumping wells, piezometers, and other site features, which are designated to remain in-place; to safeguard people and property; to minimize traffic inconvenience; to minimize dust and odors; and to provide safe working conditions.
- B. The CONTRACTOR shall repair, to the GROUP's REPRESENTATIVE's satisfaction, and at no additional expense or delay to the GROUP, any and all damages, which occurs as a result of this demolition work.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

3.01 GENERAL

- A. The CONTRACTOR shall remove the existing office trailers from the Site, and demolish its associated foundation supports. In addition, the CONTRACTOR shall cut and cap all utility services (i.e., sanitary sewer, water, electric, and telephone) associated with this existing office trailer.
- B. The CONTRACTOR shall demolish the designated buildings and utilities, as indicated on the Contract Drawings. The base building slab and foundations shall remain, as necessary, in-place to facilitate the construction of a new pre-fabricated metal structure. Prior to construction of the specified pre-fabricated metal structure, CONTRACTOR shall clean and protect all floors to remain to the GROUP's REPRESENTATIVE satisfaction.
- C. The CONTRACTOR shall decommission and dismantle the existing groundwater extraction system, including all existing pumping wells, selected piezometers, aboveground piping, vaults, aboveground storage tank, and control systems. Pumping wells and piezometers will be decommissioned per Section 02070 of these Technical Specifications.
- D. Over the entire duration of remedial construction activities on-Site, the CONTRACTOR shall provide, erect, and maintain suitable barriers, or other controls to ensure that unauthorized personnel do not enter the Site.

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- E. Demolition activities shall conform to applicable codes for demolition of structures, safety of adjacent structures, dust control, noise control, service utilities and hazardous materials handling. Work shall be conducted without interference to public or accesses to public areas.
- F. Blasting and/or burning of materials, waste, and/or debris materials shall not be permitted for this Contract.

3.02 ENVIRONMENTAL DECOMMISSIONING

- A. Prior to dismantling, the existing groundwater extraction system and leachate holding tank shall be cleaned of all residual material and decontaminated, in accordance with all applicable Federal, State and local regulations.
- B. The existing groundwater extraction system piping shall be dismantled and disposed of off-Site, in accordance with all applicable regulations, at an off-Site facility approved by the GROUP.
- C. The existing aboveground leachate-holding tank shall be rendered unusable and disposed of off-Site, in accordance with applicable regulations, at a facility approved by the GROUP.
- D. The CONTRACTOR shall take all appropriate health and safety measures, including air monitoring, as necessary, per its approved HASP.

3.03 DEMOLITION

- A. All piping, conduits, or other underground lines leading to/from the buildings shall be decommissioned by the CONTRACTOR in accordance with Federal, State, and Local requirements.
- B. Fire protection systems (if present) shall be maintained, as appropriate throughout the Work.
- C. The CONTRACTOR shall establish and maintain noise, dust, and air quality monitoring systems, in accordance with Sections 01562, 01563, and 01564 of these Technical Specifications.
- D. The CONTRACTOR shall identify, disconnect, and cap all existing utilities (i.e., sanitary sewer, water, electric, and telephone), as applicable.
- E. The CONTRACTOR shall demolish the all structures designated for removal in an orderly and careful manner using conventional techniques. All building materials/demolition debris shall be disposed of off-Site at a facility approved by the GROUP.

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- F. Walls, vaults, manholes, utilities, and other infrastructures designated for removal by the CONTRACTOR shall be removed completely, unless noted on the Contract Drawings and/or directed by the REMEDIAL DESIGNER.
- G. The CONTRACTOR shall ensure that Site drainage, drainage structures, natural drainage channels are not obstructed, per local and/or State requirements, and provide protective measures to prevent solids and debris from entering drainage structures or storm drains.
- H. Discharge of any water and/or liquids generated over the course of remedial construction activities shall not be permitted, unless authorized by the GROUP'S REPRESENTATIVE.
- I. Combustible materials shall be removed from the work site as demolition progresses.

3.04 CLEANUP AND BACKFILL

- A. The CONTRACTOR shall conduct its demolition cleanup work in accordance with the following items:
 - 1. Remove materials generated during demolition as Work progresses.
 - 2. Leave areas of Work in clean condition.
 - 3. Remove temporary construction fence and gates, as applicable.
 - 4. Clean up the Site thoroughly upon final surface restoration.
 - 5. All temporary control and utility items shall be protected until completion of demolition efforts.
- B. The CONTRACTOR shall backfill all ground surface depressions and/or voids created during the course of this demolition work, in accordance with Section 02223 of these Technical Specifications.

3.05 MANAGEMENT OF DEMOLITION DEBRIS

- A. The CONTRACTOR shall manage demolition debris generated on the premises for transport to a pre-approved licensed solid waste or construction disposal facility, in accordance with Section 02221 of these Technical Specifications.

END OF SECTION

SECTION 02070

WELL DECOMMISSIONING

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. This Section describes the general requirements for decommissioning the specified existing piezometers, monitoring wells, and pumping wells, as indicated on the Contract Drawings.
- B. Comply with all applicable codes, ordinances, rules, regulations and laws of local, State, and Federal authorities having jurisdiction. CONTRACTOR shall furnish all permits, materials, labor, equipment, tools and appurtenances required to complete the Work as described herein.
- C. The term “well” refers to monitoring wells, pumping wells, and/or piezometers, unless specifically noted.
- D. All piezometers and wells designated for removal shall be decommissioned in accordance with all NJDEP well abandonment procedures, in accordance with N.J.A.C. 7:9.

1.02 SUBMITTALS

- A. Within two (2) weeks after the completion of the well decommissioning, the CONTRACTOR shall submit to the REMEDIAL DESIGNER the following documentation:
 - 1. Method and equipment used to seal the well(s);
 - 2. Well depth to the nearest 0.1 feet;
 - 3. Depth to water to the nearest 0.1 feet;
 - 4. Volume of grout used;
 - 5. Grout mix proportions; and
 - 6. Copies of all NJDEP well decommissioning forms.
- B. Submit in accordance with Section 01300 of these Technical Specifications.

1.03 QUALITY ASSURANCE

- A. Observation and testing: All well decommissioning operations shall be conducted under the observation of the QUALITY ASSURANCE OFFICER (QAO).
- B. All work is to be performed in accordance with all applicable State and Federal regulations.

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1.04 QUALIFICATIONS

- A. Well Decommissioning Personnel: Drillers, as necessary, must be licensed in the State of New Jersey. Drillers must have knowledge of well construction and geologic conditions of the area, and must have familiarity with procedures presented in this Section. Copies of the driller's New Jersey well driller's registrations shall be provided to the REMEDIAL DESIGNER and QAO prior to conducting this Work.

1.05 SCHEDULING

- A. Schedule Work prior to cap construction to coincide with construction of new groundwater monitoring wells, pumping wells, and/or piezometers.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. All materials shall be in accordance with applicable local, State, and Federal requirements.
- B. Grout mixtures shall be in accordance with the grout manufacturer's specifications.

2.02 EQUIPMENT

- A. Drilling Equipment: Drill rig consisting of hollow stem auger, or appropriate drilling equipment pre-approved by the REMEDIAL DESIGNER, for re-drilling the boring at each well location.
- B. Provide the following as indicated:
 - 1. Grout pump capable of pumping specified grout mixture to the required depths.
 - 2. Tremie pipe of sufficient length to reach within one (1) foot of the bottom of well.
 - 3. Mud tub, barrel or tank of sufficient volume to adequately mix and hold grout prior to placement in the borehole.

PART 3 – EXECUTION

3.01 GENERAL

- A. The wells to be decommissioned are indicated on the Contract Drawings.

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3.02 PROCEDURE

- A. All piezometers and wells designated for removal shall be decommissioned in accordance with all NJDEP well abandonment procedures, in accordance with N.J.A.C. 7:9.
- B. Depths to water and total depths shall be measured for each well before abandoning. Measurement shall be made to the nearest 0.1 foot. Measurements shall be made from the top of well casing and ground level.
- C. Surface protective casings shall be removed.
- D. Vertical riser pipes shall be cut four (4) feet below bottom of proposed final cover grade or existing ground surface, whichever is lower.
- E. Vertical riser pipes shall then be grouted using a tremie pipe and grout mixed in accordance with the requirements of Article 2.01-B herein.

3.03 DISPOSAL OF DEBRIS

- A. Debris, including steel casing, vertical riser pipe, and concrete (poured around steel protective casing) resulting from the work of this Section shall be cut, crushed and/or broken into pieces no greater than six (6) inches in any dimension, and placed in an on-site waste disposal area designated by the GROUP's REPRESENTATIVE.

3.04 LIQUIDS HANDLING

- A. All aqueous and non-aqueous liquids used, collected, or encountered during the performance of this Work shall be handled in accordance with Section 02402 of these Specifications.

*****END OF SECTION*****

SECTION 02100

SITE PREPARATION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall furnish all permits, materials, labor, equipment, tools and appurtenances required to complete the Work as described herein. The CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect all Work.
- B. This Section describes materials and equipment to be utilized, and requirements for their use in preparing the Site for construction.
- C. The CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations and laws of local, State or Federal authorities having jurisdiction.
- D. The CONTRACTOR shall remove, transport, and dispose of removed geomembrane materials at a permitted, off-site disposal facility acceptable to the GROUP's REPRESENTATIVE. The CONTRACTOR shall provide all equipment, materials, and personnel necessary to remove and transport these materials to the designated areas.
- E. Protect and maintain existing piezometers, monitoring wells, vents, structures, fences, benchmarks, monuments, and other reference points. Re-establish, at no cost to the GROUP, any such reference points, if disturbed or destroyed by CONTRACTOR. The CONTRACTOR's surveyor shall conduct a survey of all monuments and property markers within proposed Work areas prior to any disturbance so that they can be re-established if disturbed by the CONTRACTOR as part of this Contract.
- F. Protect and maintain all existing groundwater monitoring wells, piezometers, utility poles, fences and all other facilities that are designated to remain in-place, as indicated on the Contract Documents.
- G. Protect any existing facilities, utilities, and structures from damage due to construction.

1.02 RELATED SECTIONS

- A. 01540 – Job Site Security
- B. 01550 – Site Access and Traffic Control
- C. 01562 – Dust Control
- D. 01563 – VOC, Odor, Vector and Spill Control

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- E. 01564 – Health and Safety
- F. 02110 – Site Clearing and Grubbing
- G. 02220 – Excavation

PART 2 – PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

*****END OF SECTION*****

SECTION 02110

SITE CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall furnish all materials, labor, equipment, tools and appurtenances required to complete the work as described below. The CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect all Work.
- B. Site clearing includes, but is not limited to, removing from the construction area, hauling to a permitted, off-Site disposal area acceptable to the GROUP's REPRESENTATIVE, and disposing of trees, stumps, roots, brush, structures, abandoned utilities, trash, debris, existing geomembrane liner materials, and all other materials found on or near the surface of the ground within the construction Work areas.
- C. The CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations and laws of local, State, and Federal authorities having jurisdiction.
- D. No clearing and grubbing shall be allowed without adequate soil erosion and sedimentation control measures in-place to the satisfaction of the GROUP's REPRESENTATIVE, and as described in the Contract Documents.
- E. In areas where waste is exposed by clearing and grubbing, odor and/or vector controls, as outlined in Section 01563 of these Technical Specifications, shall be implemented, as necessary.

1.02 RELATED SECTIONS

- A. 01562 – Dust Control
- B. 01563 – VOC, Odor, Vector and Spill Control
- C. 01564 – Health and Safety
- D. 02100 – Site Preparation
- E. 02125 – Erosion and Sediment Control
- F. 02220 – Excavation

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1.03 JOB CONDITIONS

- A. Location of Work: Areas to be cleared and grubbed include all areas designated for capping and soil cover placement, laydown area(s), on-Site borrow areas, designated access roads, construction of stormwater management system, installation of fences, installation of an enhanced groundwater extraction system, and all areas identified in the Contract Documents associated with the OU-2 Remedial Action.

PART 2 - PRODUCTS

- A. The CONTRACTOR shall furnish equipment of the type normally used in clearing and grubbing operations including, but not limited to, dozers, shears, skidders, loaders, root rakes, chipping equipment and stump grinders.

PART 3 - EXECUTION

3.01 SCHEDULING OF CLEARING

- A. The existing geomembrane liner system shall be removed and disposed of off-Site as part of the specified clearing and grubbing operations. The existing geomembrane liner material shall also be removed in a systematic, sequential process to mitigate dust and odor issues. When the CONTRACTOR removes any portion(s) of the existing geomembrane liner materials, it shall implement and maintain all necessary dust and odor control measures, as specified under Sections 01562 and 01563 of these Technical Specifications.
- B. Areas to be capped shall be grubbed, and stumps and roots removed to a depth not less than two (2) feet below the subgrade elevations shown on the Contract Drawings, as necessary.
- C. The GROUP's REPRESENTATIVE may permit clearing of additional areas provided that temporary erosion and sedimentation controls are in-place in accordance with Section 02125 of these Specifications.

3.02 CLEARING AND GRUBBING PROCEDURES

- A. Materials to be cleared, grubbed and removed from the construction areas include, but are not limited to, trees, stumps, roots, brush, trash, organic matter, debris, and existing geomembrane liner materials.
- B. Grubbing shall consist of completely removing roots, stumps, trash and other debris from all graded areas, so that surface material is free of roots and debris. Surface material is to be left sufficiently clean so that further picking and raking will not be required.

- C. Stumps, roots, foundations and planking embedded in the ground shall be removed and properly disposed at a permitted disposal facility acceptable to the GROUP's REPRESENTATIVE.
- D. Surface rocks and boulders greater than six (6) inches in diameter shall be grubbed from the soil and properly disposed at a permitted disposal facility acceptable to the GROUP's REPRESENTATIVE.
- E. Where tree limbs interfere with utility wires, or where trees to be felled are in proximity to utility wires, these trees shall be taken down in sections to reduce the possibility of damage to the utility wires. The CONTRACTOR shall be responsible for damages to utilities, and consequential damages to the GROUP and third parties, and shall replace/repair damaged utilities at no cost to the GROUP.
- F. Any Work pertaining to utility poles and guy wires shall comply with the requirements of the appropriate utility.
- G. Stumps and roots shall be grubbed and removed to a depth not less than two (2) feet below subgrade as indicated on the Contract Drawings. All holes or cavities which extend below the subgrade elevation of the proposed work shall be backfilled with soil or other suitable material, compacted to a similar density as the surrounding material. Roots ½-inch in diameter and greater shall be removed to a depth not less than six (6) inches below subgrade.
- H. The CONTRACTOR shall be held liable for any direct or consequential damage to property outside of the designated Work area(s).
- I. The CONTRACTOR shall be responsible for all damages to existing structures and/or improvements resulting from the Work.
- J. The CONTRACTOR shall protect and maintain all existing piezometers, wells, fencing, and any other facilities or structures that are designated to remain from damage due to on-going construction activities. Damaged items shall be repaired or replaced at no cost to the GROUP.

3.03 DISPOSAL OF DEBRIS

- A. Debris (i.e., stumps, roots, branches, leaves, existing geomembrane liner materials, etc.) resulting from the Site clearing and grubbing operations shall be removed and properly disposed at a permitted disposal facility acceptable to the GROUP's REPRESENTATIVE.

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- B. All trees and shrubs from the clearing operation shall be chipped on-Site. Chipped material from portions of trees and shrubs above grade (trunks, branches) may be composted and used as mulch on revegetated areas, or for temporary erosion control measures. Mulch made from chipping and shredding on-site materials shall meet the applicable mulch requirements listed in Section 02125 of these Specifications.
- C. Large debris (i.e., stumps, etc.) shall be cut, shredded, or crushed into pieces no greater than six (6) inches in any dimension and properly disposed at a permitted disposal facility acceptable to the GROUP's REPRESENTATIVE.

*****END OF SECTION*****

SECTION 02125

EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall provide all materials, and shall promptly take all actions necessary to achieve effective erosion and sediment control in accordance with all applicable local, State, and Federal enforcing agency guidelines and these Specifications.
- B. The Contract Documents shall be considered minimum requirements for erosion and sediment control, and shall not relieve the CONTRACTOR of the responsibility to actively take all steps necessary to control soil erosion and sediment in all areas associated with the Work. The CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect all erosion and sediment control work. The QUALITY ASSURANCE OFFICER (QAO) will confirm satisfactory implementation of the Work.
- C. The CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations and laws of local, State, and Federal agencies having jurisdiction. The CONTRACTOR must provide a Site-specific Erosion and Sediment Control Plan to the REMEDIAL DESIGNER for review prior to submitting it to the appropriate authorities for approval. The CONTRACTOR, the REMEDIAL DESIGNER, and the GROUP's REPRESENTATIVE shall work together with the reviewing agencies as required, attend meetings (as necessary), and answer all questions/comments to the satisfaction of the agencies. The CONTRACTOR is responsible for obtaining all other necessary State and local permits required for the Work.
- D. The CONTRACTOR shall not proceed with construction until the Site-specific Erosion and Sediment Control Plan is approved by REMEDIAL DESIGNER and the reviewing agencies.
- E. The CONTRACTOR shall repair and/or replace any materials damaged by erosion or covered with sediment, at no additional cost to the GROUP.
- F. Temporary erosion and sediment control features installed by the CONTRACTOR shall be maintained by the CONTRACTOR until no longer needed, and as determined by the GROUP's REPRESENTATIVE and/or QAO, or until permanent erosion and sediment control measures are installed/established.

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- G. It shall be the sole responsibility of the CONTRACTOR to properly schedule and coordinate all necessary labor, equipment, and materials such that the specified Work is performed in accordance with the Construction Schedule and the Contract requirements. The GROUP's REPRESENTATIVE or QAO may reject or direct the CONTRACTOR to repair, at the CONTRACTOR's own expense, those items which are detrimental to the Work or not in compliance with the Contract Documents. Such direction or rejection by the GROUP's REPRESENTATIVE or QAO shall not relieve the CONTRACTOR of his obligation to properly schedule and perform other specified Work items in conformance with the Contract Documents.
- H. All imported material shall be from sources which have approved Soil Erosion and Sediment Control Plans in effect.

1.02 SUBMITTALS

- A. The CONTRACTOR shall submit manufacturer's material data sheets and guidelines for installation of silt fence and other manufactured erosion and sediment control devices as necessary for the Work.
- B. The CONTRACTOR shall submit a Site-specific Erosion and Sediment Control Plan (Plan) to the REMEDIAL DESIGNER for review within twenty (20) business days after the date of commencement as stated in the Notice to Proceed and no less than thirty (30) calendar days prior to the commencement of construction activities. The Plan shall meet the minimum requirements outlined in the Article 1.01C above, State and local soil erosion and sediment control regulations, and these Specifications.
- C. Submit in accordance with Section 01300 of these Technical Specifications.

1.03 RELATED SECTIONS

- A. 02100 – Site Preparation
- B. 02110 – Site Clearing and Grubbing
- C. 02140 – Control of Water
- D. 02210 – Site Grading
- E. 02220 – Excavation
- F. 02221 – Soil and Waste Disposal
- G. 02223 – Backfill and Fill
- H. 02224 – Cover Soil
- I. 02225 – Vegetative Support Layer
- J. 02233 – Aggregate Materials
- K. 02274 – Stone Riprap
- L. 02936 – Seeding

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1.04 COMPLIANCE WITH REGULATIONS

- A. All soil erosion and sediment control measures shall be constructed and maintained in accordance with the *Standards for Soil Erosion and Sediment Control in New Jersey* (July 1999) (Standards). Where the Standards and these specifications differ, the CONTRACTOR shall employ the most stringent requirement or request clarification from the REMEDIAL DESIGNER.

PART 2 - PRODUCTS

2.01 SILT FENCE

- A. Silt fences shall be a woven geotextile attached to wooden or steel posts as detailed on the Contract Drawings, or as recommended by the manufacturer, whichever is more stringent.

2.02 BALES

- A. Straw bales shall be clean, seed-free oat or wheat types.

2.03 SEEDING

- A. In accordance with Section 02936 of these Technical Specifications.

2.04 FERTILIZER

- A. In accordance with Section 02936 of these Technical Specifications.

2.05 MULCH

- A. Straw mulch shall be oat or wheat straw, free from weeds or foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable. Straw mulch shall be properly anchored.
- B. Wood fiber mulch shall consist of wood fiber produced from clean, whole-uncooked wood, formed into resilient bundles having a high degree of internal friction, and shall be dry when delivered to the Site.
- C. Mulch shall be applied at a rate of two (2) tons per acre.

2.06 WATER

- A. In accordance with Section 02936 of these Technical Specifications.

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2.07 LIME

- A. In accordance with Section 02936 of these Technical Specifications.

2.08 TEMPORARY EROSION CONTROL MAT

- A. Temporary Erosion Control Mat shall be Landlok ECB CS2, North American Green's SC150, or an alternate as favorably reviewed by the REMEDIAL DESIGNER.

2.09 PERMANENT EROSION CONTROL MAT/TURF REINFORCEMENT MAT (TRM)

- A. Permanent Erosion Control Mat, or Turf Reinforcement Mat (TRM), shall be Enkamat 7010, Landlok 450, or an alternate as favorably reviewed by the REMEDIAL DESIGNER.

2.10 STONE RIPRAP

- A. Stone riprap shall be as defined in Section 02274 of these Technical Specifications.

PART 3 - EXECUTION

3.01 GENERAL

- A. CONTRACTOR shall be responsible for the control, collection, and management of water accumulations on-Site prior to, during, and following the systematic, sequential removal of the existing geomembrane liner materials and installation of the proposed, new cap system.
- B. Conduct earthwork and excavation activities in such a manner to fit the topography, soil type, and condition.
- C. Minimize the area being disturbed and the duration of exposure to erosion elements such that only one month's work is exposed at any given time.
- D. Stabilize disturbed areas immediately.
- E. Retain on-Site, sediment that was generated on-Site.
- F. Prevent silt and sediment from entering any watercourse if soil erosion cannot be prevented.
- G. Prevent silt and sediment from migrating downstream in the event it cannot be prevented from entering the watercourse.

- H. The GROUP's REPRESENTATIVE may limit the surface area of erodible material exposed by clearing and grubbing, and direct the CONTRACTOR to provide immediate temporary or permanent control measures to prevent sediment impacts on nearby watercourses.
- I. Where erosion is likely to be a problem, clearing and grubbing operations shall be scheduled and performed such that grading operations and permanent erosion and sediment control features can follow immediately thereafter, if the Work conditions permit; otherwise, erosion and sediment control measures may be required between successive construction stages.
- J. In the event that additional temporary erosion and sediment control measures are required due to the CONTRACTOR's negligence, carelessness or failure to install permanent controls as a part of the Work schedule, or are ordered by the GROUP's REPRESENTATIVE, USEPA, NJDEP, Bergen County, or other regulatory authority having jurisdiction, such Work shall be performed by the CONTRACTOR, at no additional cost to the GROUP, and no time extensions shall be granted.

3.02 TEMPORARY EROSION AND SEDIMENT CONTROL

- A. Temporary erosion and sediment control measures shall be used to correct conditions that develop during construction and lead to soil erosion or deposition of waterborne sediments, that are needed prior to installation of permanent erosion and sediment control features, or that are needed temporarily to control erosion and/or sediment that develops during normal construction practices, but are not associated with permanent control features for the Work.
- B. Temporary erosion and sediment control devices shall be installed and maintained prior to initial land disturbance activities, and shall be maintained until satisfactory completion or establishment of permanent erosion control measures. At that time, temporary measures shall be removed upon approval by the QAO.
- C. The CONTRACTOR shall coordinate the installation of temporary erosion and sedimentation control provisions contained herein with the permanent erosion control features to ensure economical, effective and continuous erosion and sediment control throughout the construction and post-construction period.
- D. Silt fences, barriers, temporary sedimentation basins, and other temporary measures shown on the CONTRACTOR's approved Site-specific Erosion and Sediment Control Plan shall be installed as indicated and shall be maintained until no longer needed, or as determined by the GROUP's REPRESENTATIVE. At that time, the items shall be removed by the CONTRACTOR. All temporary

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items and devices must be removed with the approval of the GROUP's REPRESENTATIVE prior to final demobilization from the Site.

- E. Where permanent vegetation is not appropriate, and where the CONTRACTOR's temporary erosion and sediment control practices are inadequate, the CONTRACTOR shall provide a temporary vegetative cover.
- F. All erosion and sediment control devices shall be inspected by the CONTRACTOR at least weekly, after each rainfall occurrence, and cleaned out, and repaired by the CONTRACTOR, as necessary.

3.03 TEMPORARY EROSION AND SEDIMENT CONTROL TECHNIQUES

A. Temporary Diversion Berms

- 1. A temporary diversion berm is constructed of compacted soil, with or without a shallow ditch, at the top of fill slopes.
- 2. These diversion berms are used temporarily at the top of newly constructed slopes to prevent excessive erosion until permanent controls are installed or slopes stabilized.
- 3. A temporary diversion berm shall be constructed of compacted soil, with a minimum width of twenty-four (24) inches at the top and a minimum height of twelve (12) inches with or without a shallow ditch. Side slopes shall be three horizontal to one vertical (3H:1V) or less. The minimum longitudinal (crest) slope is one (1) percent; while the maximum is five (5) percent.
- 4. The maximum contributing drainage area for a temporary diversion berm is three (3) acres.

B. Sediment Control Structures

- 1. Sediment basins, ponds, and traps are prepared storage areas constructed to trap and store sediment from erodible areas in order to protect stream channels or water bodies below the construction areas from excessive siltation.
- 2. Sediment structures shall be utilized to control sediment where slope drains outlet. All sediment structures shall be at least twice as long as they are wide.
- 3. When use of temporary sediment structures is to be discontinued, all sediment accumulation shall be removed, excavation backfilled, and properly compacted. The existing ground shall be restored to its natural or intended condition.

C. Stone Riprap

- 1. Unless otherwise indicated on the Contract Drawings or otherwise directed by the GROUP's REPRESENTATIVE, stone riprap shall be placed at all points where banks of drainage ditches are disturbed by

excavation. Temporary erosion control mat may be used in these areas with the approval of the GROUP's REPRESENTATIVE. The subgrade shall be carefully compacted and stone riprap placed to prevent subsequent settlement and erosion. This requirement applies equally to construction alongside a drainage ditch as well as crossing a drainage ditch.

D. Straw Bales

1. Straw bales are temporary measures to control erosion and retain the suspended silt particles in the runoff water leaving disturbed areas. Bales shall contain five (5) cubic feet or more of material.
2. Straw bales shall be embedded in the ground four (4) to six (6) inches to prevent water flowing under them. The bales shall also be anchored securely to the ground by stakes or rods driven through the bales into the ground, as indicated on the Contract Drawings. Bales shall be removed after they have served their purpose, as determined by the GROUP's REPRESENTATIVE.
3. The CONTRACTOR shall keep the bales in good condition by replacing broken or damaged bales immediately after damage occurs. Normal debris clean out will be considered routine maintenance.
4. Straw bales shall be used at the toe of fill slopes, in ditches, or other areas where siltation, erosion, or water run-off is a problem.
5. Bales shall be placed so that the predominant direction of the straw stalk is oriented perpendicular to the surface water flow direction.

E. Silt Fences

1. Silt fences are temporary measures utilizing woven wire, or other approved materials, attached to posts with a woven geotextile attached to the upstream side of the fence to retain the suspended silt particles in the runoff water.
2. Temporary silt fences shall be placed on the natural ground, at the toe of fill slopes, in ditches around soil stockpiles, or other areas where siltation, erosion, or water run-off is a potential problem. Temporary silt fences shall be anchored as indicated on Contract Drawings.
3. The CONTRACTOR shall be required to maintain silt fences in a satisfactory condition for the duration of the Work, or until removal is authorized by the QAO. The silt accumulation at the fence shall be removed and placed on-Site as directed by the GROUP's REPRESENTATIVE or the QAO.
4. A grassed strip five (5) feet wide (minimum) shall remain in-place, immediately downgradient of each silt fence.

F. Temporary Vegetation

1. Temporary vegetation measures consist of seeding, mulching, fertilizing, and matting utilized to reduce erosion. All cut and fill slopes shall be

seeded when and where necessary to eliminate erosion. Disturbed or bare soil areas shall not be left without stabilization for more than thirty (30) days.

2. Seeding, fertilizing, and mulching shall be performed in accordance with Articles 2.03 through 2.07 of this Section.
3. If weather conditions or time of year prevents germination, disturbed areas shall be protected by installing a temporary erosion control mat as specified in Article 2.08.

G. Temporary Erosion Control Matting

1. Temporary erosion control mat shall be installed immediately after seeding.
2. Any area disturbed and inactive for more than fifteen (15) days shall receive temporary seeding (unless permanent seeding is more appropriate) and temporary erosion control matting.

3.04 PERMANENT EROSION AND SEDIMENT CONTROL

- A. The CONTRACTOR shall incorporate all permanent erosion control features into the Work at the earliest practicable time as outlined in the CONTRACTOR's accepted Construction Schedule, or as land disturbance for each segment of the Work has been completed.
- B. Restore the Site to its original contours, unless otherwise shown on the Contract Drawings, or as directed by the GROUP's REPRESENTATIVE.
- C. When final grades have been established, all bare soil, unless otherwise required by the Contract Documents, shall be seeded, fertilized, and mulched in an effort to restore the area to a protected condition. Areas that are not successfully stabilized with vegetation within sixty (60) calendar days of seeding shall be reseeded at the CONTRACTOR's own expense to the satisfaction of the GROUP's REPRESENTATIVE and/or QAO.
- D. Specified permanent vegetation shall be established at the first appropriate season following establishment of final grading in each section of the Site.
- E. Permanent vegetative cover activities shall comply with local soil and water conservation guidelines.
- F. Where permanent vegetative cover cannot be immediately established (due to season or other circumstances) the CONTRACTOR shall provide temporary vegetative cover.

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3.05 PERMANENT EROSION AND SEDIMENT CONTROL TECHNIQUES

- A. Permanent Vegetation: All references to permanent vegetation, unless noted otherwise, shall relate to establishing permanent vegetative cover and be in accordance with Articles 2.03 through 2.08, inclusive, of this Section. Initial seeding of permanent vegetation shall occur within ten (10) days of final grading. Permanent vegetation will require a stand of growth of at least eighty (80) percent aerial coverage and no spots greater than 1 square yard in area, within sixty (60) days and one (1) year of the initial seeding. Otherwise, the CONTRACTOR shall re-seed at no additional cost to the GROUP.
- B. All temporary measures must remain in-place until the permanent vegetation is established, as described above. The CONTRACTOR must inspect and maintain/repair/replace all temporary measures, after every storm event and at least weekly, until the permanent vegetation is established, as described above.
- C. The CONTRACTOR, at the direction of the GROUP'S REPRESENTATIVE, shall selectively cut the established first growth within one (1) year.

*****END OF SECTION*****

SECTION 02140

CONTROL OF WATER

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. This Section covers all work necessary to control, handle and dispose of groundwater, surface water, and all other water CONTRACTOR encounters and/or generates, as required for performance of the Work and as necessary to mitigate adverse impacts and/or releases of waste materials to adjacent properties. CONTRACTOR shall be responsible for the continuous operation and maintenance of all water control measures at all times during the course of construction, and shall provide all appropriate back-up systems.
- B. Peach Island Creek Water Levels: CONTRACTOR shall obtain all relevant and necessary hydrologic records for Berry's and Peach Island Creek, as needed and required for completion of the Work. As noted on the Contract Drawings, the 100- and 500-year flood elevations are at El. +7.2 feet and El. +7.6 feet (NAVD88), respectively.
- C. CONTRACTOR shall take all steps, it deems necessary, to obtain a comprehensive knowledge of the Site subsurface and groundwater characteristics and conditions adjacent to and beneath the Work area, prior to developing and implementing any water control measure. See Section 00200 of these Technical Specifications for additional information with respect to existing Site characteristics and conditions.
- D. CONTRACTOR shall design, construct, and maintain, as it deems necessary, all temporary dikes, berms, sumps, and/or diversion/drainage channels to complete and protect the Work, as specified in the Contract Documents, and to mitigate releases of waste materials off-Site in event the Site becomes flooded during construction. CONTRACTOR shall remove all temporary water control measures at completion of the Work.
- E. CONTRACTOR shall be responsible for the stability of all temporary and permanent slopes, grades, foundations, materials, and structures during the course of the Work. Repairs to and/or replacement of slopes, grades, foundations, materials, and structures damaged by water, both surface and subsurface, shall be CONTRACTOR's own expense.
- F. CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect all Work.
- G. CONTRACTOR shall provide measures to minimize accumulation of surface water in Work areas.

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- H. CONTRACTOR shall segregate all surface water runoff and waters from groundwater, which may be encountered by CONTRACTOR during its excavation operations. All surface water and perched groundwater encountered by CONTRACTOR shall be collected, pumped, contained, transferred, and temporarily stored for disposal in accordance with Section 02402 of these Technical Specifications.

1.02 RELATED SECTIONS

- A. Section 01564 – Health and Safety
- B. Section 02110 – Site Clearing and Grubbing
- C. Section 02125 – Erosion and Sediment Control
- D. Section 02210 – Site Grading
- E. Section 02220 – Excavation
- F. Section 02221 – Soil and Waste Disposal
- G. Section 02402 – Liquids Handling and Disposal

1.03 SUBMITTALS

- A. CONTRACTOR shall submit, as part of its overall Work Plan (per Section 01300 of these Technical Specifications), specific details, description, drawings, and relevant design information regarding its proposed means-and-methods for controlling all surface and subsurface waters encountered and/or generated over entire the course of the Work, including, but not limited to: a) equipment; b) procedures and methods; c) standby equipment and power supplies; d) means of measuring collected/contained inflows and off-Site discharges; and e) back-up systems.
- B. CONTRACTOR shall submit, as part of its overall Work Plan (per Section 01300 of these Technical Specifications), a detailed Site Flooding Contingency Plan, including specific details, methods, procedures, protocols, and measures to be implemented in the event the Site becomes partially or fully flooded. This plan shall also indicate all pre-flooding contingency measure that would be implemented and maintained by the CONTRACTOR in attempts to mitigate releases of waste materials off-Site due to the advance and retreat of all floodwaters.
- C. CONTRACTOR shall obtain of Federal, State, and/or local permits required in connection with the handling, storage, and disposal of potentially contaminated waters, in accordance with Section 02402 of these Technical Specifications. CONTRACTOR shall submit copies of all permits to facilitate the Work.
- D. Submit in accordance with Section 01300 of these Technical Specifications.

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PART 2 – PRODUCTS

2.01 EQUIPMENT

- A. Containment barriers, piping, pumping equipment, and all other equipment and materials required for the control, handling, storage, and off-Site disposal of all collected surface and subsurface waters shall be suitable for the intended purpose. Standby equipment and supplies shall be maintained on-Site, as necessary and per the CONTRACTOR's approved Work and Site Flooding Contingency Plans, to be used in case any primary water control measures are breached.

PART 3 – EXECUTION

3.01 CONTROL OF SURFACE WATER

- A. CONTRACTOR shall intercept and/or divert all on-Site and off-Site surface water drainage away from the Work areas by the use of dikes, berms, curb walls, ditches, sumps, or other means, as necessary. CONTRACTOR shall design its surface drainage systems such that they do not result in unacceptable on- and off-Site erosion, per Section 02125 of these Technical Specifications.
- B. Design, furnish, install, maintain, monitor, operate, and remove, as necessary, all measures and equipment for the control of both on-Site and off-Site generated surface water. CONTRACTOR shall control water by means that will enable the completion of the Work, while preserving all specified final lines and grades.
- C. All pumping and drainage shall be done with no damage to adjacent properties or structures and without interference with the rights of the public, owners of adjacent properties, pedestrians, vehicular traffic, or the work of others, and in accordance with all Federal, State, and local laws, ordinances, rules, and regulations.
- D. CONTRACTOR shall obtain all necessary permits (equivalencies) for collection, handling, storage, off-Site disposal, and on-Site discharge to surface waters. All surface and subsurface water encountered during the course of the Work shall be handled and disposed of in accordance with Section 02402 of these Technical Specifications.
- E. CONTRACTOR shall separate, segregate all collected surface and subsurface waters encountered and collected over the entire course of the Work. All surface water coming in direct contact with any on-Site waste materials and all subsurface water generated during the CONTRACTOR excavation activities on-Site shall be considered contaminated, and shall be collected, segregated, temporarily stored on-Site, and disposed off-Site, in accordance with Section 02402 of these Technical Specifications.

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- F. After they have served their purpose, CONTRACTOR shall remove all temporary water control measures at a time and in a manner approved by the REMEDIAL DESIGNER.

3.02 CONTROL OF WATER WITHIN EXCAVATIONS

- A. By the use of pumps, tile drains, or other approved methods, CONTRACTOR shall control the flow and accumulation of water in excavated areas to prevent excessive softening, flotation of structures, damage to foundations, and disturbance of exposed soils in excavations, as necessary, for completion of the Work.
- B. CONTRACTOR shall control subsurface groundwater and surface water inflows such that the required excavations and backfill activities may be performed under suitable and safe working conditions. CONTRACTOR shall monitor and record, on a daily basis, the total volume of subsurface water collected per calendar day using measuring devices reviewed and accepted by the GROUP's REPRESENTATIVE and REMEDIAL DESIGNER.
- C. Upon commencement of any dewatering activities, any noticeable settlement, visual or measured, of any structures within proximity of the Site shall be reason for termination of all associated dewatering activities. If dewatering activities are terminated due to adverse impacts on adjacent properties and/or structures, CONTRACTOR shall complete the Work by using alternate means and methods (i.e., other than dewatering), which will mitigate the identified adverse impacts to the adjacent properties and structures in question. All additional Work required to mitigate adverse impacts to adjacent properties and/or structures shall be done at CONTRACTOR's expense.

3.03 HANDLING, STORAGE, AND DISPOSAL OF WATER

- A. All surface and subsurface encountered, generated, and collected over the entire duration of construction shall be handled, temporarily stored on-Site, and disposed of off-Site in accordance with Section 02402 of these Technical Specifications.

3.04 REPAIR AND CLEAN UP

- A. Upon completion of all surface and subsurface water control activities, CONTRACTOR shall remove, the GROUP's REPRESENTATIVE's and REMEDIAL DESIGNER's satisfaction, all equipment, materials, and temporary structures/measures implemented to control surface and subsurface waters encountered during the Work.
- B. CONTRACTOR shall promptly repair and/or replace all damaged on-Site and off-Site adjacent properties, structures, and/or facilities to the satisfaction of the GROUP's REPRESENTATIVE and the REMEDIAL DESIGNER.

*****END OF SECTION*****

SECTION 02150

SHORING AND BRACING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The Work of this Section pertains to excavations described in Section 02220. CONTRACTOR shall furnish all labor, materials, equipment, tools, services, and all other related items necessary to complete the Work of shoring, bracing, and sheeting necessary to complete construction, protect structures, roads, utilities, underground piping and manholes, slopes and grades, and prevent losses of ground or caving of embankments. All such shoring and bracing shall meet all applicable building and safety codes. CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect all shoring and bracing work.
- B. CONTRACTOR shall be solely responsible for proper excavation procedures including, but not limited to, maintenance of safe slope angles and the design and use of properly designed and installed shoring and bracing systems in accordance with OSHA and all other applicable standards and requirements. As required, shoring and bracing shall be designed by the CONTRACTOR's engineer who is a licensed and registered Professional Engineer in the State of New Jersey. Upon completion of associated excavation activities, remove all shoring and bracing without disturbing backfill, bedding, or pipes. The presence of the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, or QUALITY ASSURANCE OFFICER (QAO) shall not relieve the CONTRACTOR of its responsibility in properly designing, installing and maintaining adequate shoring and bracing systems. The GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, or QAO shall not be the "Competent Person" on-site.
- C. The applied lateral earth pressures imposed on the shoring and bracing, and the stability of the shoring and bracing and excavation bottom are dependent not only on existing subsurface soil and refuse conditions, but also the CONTRACTOR's construction sequences, procedures, and options such as dewatering, staging of excavation, installation of bracing, flexibility of shoring and bracing, operation of heavy construction equipment, location of stockpiles, adjacent structures, and the time to complete the Work. All such factors shall be considered and investigated as part of the design of the shoring and bracing system.
- D. CONTRACTOR shall comply with all applicable codes, ordinances, rules, regulations, and laws of local, State, and Federal authorities having jurisdiction. The GROUP's REPRESENTATIVE will monitor satisfactory implementation of the Work, but will not be responsible for assessing the degree of CONTRACTOR's compliance to the above items.

1.02 RELATED SECTIONS

- A. 01564 – Health and Safety
- B. 02125 – Erosion and Sediment Control

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- C. 02220 – Excavation
- D. 02221 – Soil and Waste Disposal
- E. 02223 – Backfill and Fill
- F. 02233 – Aggregate Materials
- G. 02402 – Liquids Handling and Disposal
- H. 02612 – Reinforced Concrete Pipe
- I. 02613 – Corrugated Metal Pipe
- J. 02614 – Corrugated Polyethylene Pipe
- K. 02615 – High Density Polyethylene Pipe

1.03 SUBMITTALS

- A. In cases where excavations may jeopardize adjacent Site areas, or the stability of nearby structures, piping, manholes, grades, slopes, or facilities, CONTRACTOR shall submit results of any additional subsurface explorations, drawings, design calculations and substantiating data prepared, signed, and sealed by a Professional Engineer licensed and registered in the State of New Jersey, showing the proposed shoring and bracing system design and construction sequences and procedures for review and approval by the GROUP's REPRESENTATIVE prior to initiation of construction activities.
- B. Shoring and bracing systems shall be designed such that their removal shall not jeopardize Work already performed. Shoring and bracing systems shall not remain permanently in-place without written approval of the GROUP's REPRESENTATIVE.
- C. Any review and/or comments provided to the CONTRACTOR by the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, or QAO shall not relieve the CONTRACTOR of the responsibility to design adequate and safe shoring and bracing systems.
- D. Within trenches, shoring and bracing systems shall be designed such that the lowest horizontal brace is no closer than twelve (12) inches above the base of excavation.
- E. Submit in accordance with Section 01300 of these Technical Specifications.

1.04 RELATED REFERENCES

- A. Recommended Technical Provisions for Shoring and Sloping of Trenches and Excavations, U.S. Department of Commerce.
- B. Construction Safety and Health Regulations, U.S. Department of Labor, Occupational Safety and Health Administration.
- C. Occupational Safety and Health Regulations-Excavations, U.S. Department of Labor, Occupational Safety and Health Administration, 29 CFR Part 1926.

1.05 QUALITY CONTROL

- A. During installation of required shoring and bracing systems, and as long as the excavation remains open, CONTRACTOR's designated "Competent Person" shall monitor the shoring and bracing installation sequences and procedures to ensure that it is carried out in accordance with the design.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. All materials shall meet, or exceed, the minimum requirements of applicable codes and those conditions assumed during the shoring and bracing system design submitted by the CONTRACTOR.

PART 3 - EXECUTION

3.01 VERIFYING EXISTING CONDITIONS

- A. Prior to start of Work, CONTRACTOR shall check and verify all governing dimensions and elevations, including field measurements of existing and adjoining work and existing structures and features on which the design is dependent.

3.02 GENERAL

- A. The CONTRACTOR shall furnish, install, and maintain sheeting and bracing or other means, required to support the sides of the excavation, and to prevent loss of ground which could endanger lives, damage, or delay the Work, or endanger adjacent ground, structures, or utilities. Sheeting and bracing shall be of adequate size and strength for the conditions encountered and the work being done, and shall conform to all local, State, and Federal requirements. The CONTRACTOR shall be fully responsible for the sufficiency of such sheeting and bracing.
- B. The CONTRACTOR shall be responsible for the installation of the sheeting and bracing.
- C. All sheeting and bracing shall be removed in such manner as not to endanger the construction of other structures, utilities or property.

3.03 COORDINATION WITH OTHER OPERATIONS

- A. The schedule and progress of the shoring, bracing, and sheeting work shall be coordinated with the excavation and backfilling work. If lateral movements of the shoring and bracing system and surrounding soils develop and are discovered during the excavation, CONTRACTOR shall immediately implement corrective measures to prevent further movements. Any disturbance and/or damage created by lateral movements of the shoring and bracing system, and surrounding soils, shall be repaired by the CONTRACTOR at no cost to the GROUP.

3.04 REMOVAL OF SHORING AND BRACING MATERIALS

- A. Removal of shoring and bracing systems shall be carried out in a manner such that no structures, pipelines, manholes, slopes, grades, work completed, or other facilities shall be disturbed or damaged during or after removal. Protection of structures, pipelines, manholes, slopes, grades, or other facilities during the removal of shoring and bracing systems shall be the sole responsibility of the CONTRACTOR. Disturbance or damage shall be repaired by the CONTRACTOR at no expense to the GROUP.

3.05 SAFETY

- A. Installation and removal methods for shoring and bracing systems shall meet, or exceed, the minimum design requirements and safety precautions of applicable codes, and shall be enforced by CONTRACTOR.

*****END OF SECTION*****

SECTION 02210

SITE GRADING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall furnish all labor, materials, equipment, tools and appurtenances required to complete the Work of rough and finished site grading for areas to receive landfill cap system, stormwater management structures, passive gas management system, site drainage, and general landscaping necessary for restoration of utility areas, trenches, and the overall Site. The CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect the Work.
- B. The CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations and laws of local, State, and Federal authorities having jurisdiction.

1.02 SUBMITTALS

- A. Submittals shall be made by the CONTRACTOR in accordance with Section 01300.

1.03 RELATED SECTIONS

- A. 01050 – Field Engineering/Surveying
- B. 01562 – Dust Control
- C. 01563 – VOC, Odor, Vector and Spill Control
- D. 01564 – Health and Safety
- E. 02100 – Site Preparation
- F. 02110 – Site Clearing and Grubbing
- G. 02220 – Excavation
- H. 02221 – Soil and Waste Disposal
- I. 02223 – Backfill and Fill
- J. 02224 – Cover Soil
- K. 02225 – Vegetative Support Layer
- L. 02590 – Geomembranes
- M. 02595 – Geotextiles
- N. 02598 – Geosynthetic Clay Liner
- O. 02599 – Geocomposite Drainage Layer

1.04 GENERAL

- A. Notify corporations, companies, individuals or authorities owning above- or below-ground conduits, wires, pipes, or other utilities running to the property

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prior to the start of the Work in order to verify their locations and protect them from damage.

- B. Cap, or remove and relocate, utility services in accordance with instructions by the GROUP's REPRESENTATIVE and/or utility company.
- C. Protect, support, and maintain conduits, wires, pipes or other utilities that are to remain in accordance with the requirements of the Contract Documents, and/or as required by the GROUP's REPRESENTATIVE, and/or utility company.

1.05 QUALITY ASSURANCE

- A. Testing shall be provided by the CONTRACTOR in accordance the referenced Sections of these Technical Specifications, as listed in Article 1.03 herein.
- B. Tolerances in accordance with those specified in the referenced Sections of these Technical Specifications, as listed in Article 1.03 herein.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials shall be in accordance with applicable Sections presented within the referenced Technical Specification Sections, as outlined in Article 1.03 herein.
- B. The CONTRACTOR shall certify that all imported materials are environmentally clean and shall provide analytical test results to support this certification, in accordance with N.J.A.C. 7:26E. The GROUP may elect to perform additional analytical testing, at its own cost, of samples obtained from the CONTRACTOR's off-Site source to verify that the material is environmentally clean. The CONTRACTOR shall cooperate with the GROUP in obtaining samples for this purpose. The GROUP may reject any sources proposed by the CONTRACTOR based on analytical test results or past history of the source of the material.
- A. Any imported materials from off-Site borrow sources found to not be in accordance with the Specifications, or found to be contaminated, shall immediately be removed and replaced with suitable materials at the CONTRACTOR's sole expense with no time extensions in the Construction Schedule granted. Costs associated with the QUALITY ASSURANCE OFFICER's (QAO) effort to comply with the CQAP for this replacement effort shall be borne by the CONTRACTOR as well.

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PART 3 - EXECUTION

3.01 PREPARATION

- A. Examine surfaces to receive fill to determine existence of areas loosened by frost action, softened by precipitation or flooding, or of unsuitable materials.
- B. Fill settled areas that were previously filled and where excavations or trenches were backfilled and holes made by demolition, tree removal, and other Site preparation work.
- C. Natural soils or compacted fill softened by frost, precipitation or flooding shall be removed, replaced with soils of similar characteristics, and compacted.
- D. Remove unsuitable material from under access road, driveway areas and other proposed structures shown on the Contract Documents.
- E. Maintain adequate drainage of the Site. Remove ponded water prior to grading.

3.02 FILLING AND GRADING

- A. Perform in accordance with Sections 02221 and 02223 of these Specifications.
- B. Stockpile material suitable for backfill where indicated on the Contract Drawings or designated by the GROUP's REPRESENTATIVE.
- C. Place and grade materials not suitable for backfilling or grading, and unsuitable materials in designated relocation areas or as directed by the GROUP's REPRESENTATIVE.
- D. Grade to the elevations specified by the Contract Documents.

3.03 CLEANING

- A. Excess materials shall be removed, stockpiled, or otherwise disposed by the CONTRACTOR at the direction of the GROUP's REPRESENTATIVE.

***** END OF SECTION *****

SECTION 02220

EXCAVATION

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall furnish all labor, materials, equipment, tools, and appurtenances required to complete all excavation related activities, including, but not limited to, excavations, disposal of excess and/or unsuitable materials, relocation of excavated soils to designated areas, and other related and incidental work within the designated areas and as required for the construction of other aspects of the Work, as shown, specified or required by the Contract Documents. The CONTRACTOR shall provide a “Competent Person” to implement, supervise, and inspect the Work.
- B. The Work of this Section includes, but is not limited to, excavation associated with the construction of the surface water management system; installation of culverts/pipes; construction of the engineered cap system; construction of utility trenches; and installation of an enhanced groundwater extraction system. Excavations within the limits of waste materials shall comply with Section 02221 of these Technical Specifications.
- C. The CONTRACTOR shall locate all existing active and abandoned utilities and structures in designated Work areas prior to commencing any excavation activities. The CONTRACTOR shall also protect from damage those utilities and structures which are to remain in place.
- D. The CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations and laws of local, State, or Federal authorities having jurisdiction. Comply with Section 02221 of these Technical Specifications for excavation of waste, as applicable.

1.02 RELATED SECTIONS

- A. 01050 – Field Engineering/Surveying
- B. 01550 – Site Access and Traffic Control
- C. 01562 – Dust Control
- D. 01563 – VOC, Odor, Vector and spill Control
- E. 01564 – Health and Safety
- F. 02110 – Site Clearing and Grubbing
- G. 02140 – Control of Water
- H. 02125 – Erosion and Sediment Control

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- I. 02150 – Shoring and Bracing
- J. 02221 – Soil and Waste Disposal
- K. 02223 – Backfill and Fill
- L. 02224 – Cover Soil
- M. 02225 – Vegetative Support layer
- N. 02233 – Aggregate Materials
- O. 02402 – Liquids Handling and Disposal

1.03 SUBMITTALS

- A. CONTRACTOR shall submit all necessary certifications, design, and description of construction methods for excavations made without shoring and bracing as required by Paragraph 1.05-D herein.
- B. CONTRACTOR shall submit all necessary certifications, designs, and description of construction methods for excavations where shoring and bracing is proposed as required by Section 02150 and Paragraph 1.05-E herein.
- C. Submit in accordance with Section 01300 of these Technical Specifications.

1.04 DEFINITIONS

- A. Excavation includes trenching and shall mean the removal from in-place of all materials including, but not limited to, topsoil, soil, cover soil, refuse, structures above and below ground, concrete debris, waste material, boggy waste, rubbish, tree stumps, boulders, logs, metal, ashes, cinders or organic material such as peat, humus or organic silt. Excavation of rock is not envisioned as part of this Contract.
- B. Mucking or mucking-out shall mean excavation, as defined herein, without prior dewatering.

1.05 PROTECTION OF PEOPLE AND PROPERTY

- A. The CONTRACTOR shall be responsible for the stability and safety of all of the CONTRACTOR's excavations at all times regardless of the requirements of this subsection.
- B. The CONTRACTOR shall plan and conduct his operations and take all necessary precautions to prevent damage to existing utilities, structures, roads, grades, slopes, surface water drainage features, underground piping, manholes, monitoring wells, piezometers, and other site features; to safeguard people and property; to minimize traffic inconvenience; to minimize dust and odors; and to provide safe working conditions. The CONTRACTOR shall repair, to the GROUP's REPRESENTATIVE's satisfaction, and at no additional expense or

delay to the GROUP, any and all damage which occurs as a result of the excavation work.

- C. Excavations, except as specified hereinafter, shall be adequately shored and braced in accordance with the requirements of Section 02150 of these Specifications. Where the installation of shoring and bracing is impractical or might cause damage as a result of, but not limited to, vibrations, settlements and/or lateral movements, the CONTRACTOR shall utilize other alternate methods. Excavations shall be adequately covered with temporary measures or adequately barricaded to prevent unwanted or inadvertent intrusion.
- D. Excavations may be made without shoring and bracing within the limitations and requirements of applicable governmental agencies having jurisdiction, provided that:
 - 1. Hazards, such as described herein, do not exist in the proximity of the excavation;
 - 2. Excavation depth does not exceed 4 feet, or the OSHA standards for work performed without the use of shoring and bracing, whichever is less; and
 - 3. CONTRACTOR shall submit a certification by a Professional Engineer licensed and registered in the State of New Jersey, indicating the maximum excavation side slopes proposed, and that said side slopes will remain stable under all weather and working conditions over the entire period that the excavation will be exposed. Such certification shall be based on CONTRACTOR's own subsurface exploration and consideration of available options and related work requirements, including but not limited to, dewatering, construction equipment, location of underground piping, and proximity of stockpiles and equipment. Any review and/or comments provided to CONTRACTOR by the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, or QUALITY ASSURANCE OFFICER (QAO) shall not relieve CONTRACTOR of its responsibility arising from excavation operations.
- E. In cases where excavations without shoring and bracing are not permissible because of worker safety, space limitations, or the need to minimize the disturbance of refuse, sheet piles, trench boxes, or other equivalent shoring or bracing may be used by CONTRACTOR provided that CONTRACTOR shall submit a certification by a Professional Engineer licensed and registered in the State of New Jersey, indicating the design and methods of constructing and maintaining shoring and bracing such that the shored and braced excavations will remain stable under all weather and working conditions over the entire period that the excavation will be exposed. Such certification shall be based on CONTRACTOR's own subsurface exploration and consideration of available options and related work requirements including but not limited to, dewatering,

construction equipment, location of underground piping, and proximity to stockpiles. Any review and/or comments provided to CONTRACTOR by GROUP'S REPRESENTATIVE, REMEDIAL DESIGNER, or QAO shall not relieve CONTRACTOR of its responsibility arising from excavation operations.

- F. CONTRACTOR shall haul or place all excavated materials to designated stockpile locations. Stockpile locations shall be accepted by the GROUP's REPRESENTATIVE prior to stockpiling materials. At a minimum, stockpiles shall be placed fifteen (15) feet behind and upslope from designated excavation areas. CONTRACTOR shall provide appropriate dust and odor control measures in accordance with Sections 01562 and 01563, and sediment and erosion control measures, as per Section 02125. All stockpiled materials placed outside of the landfill cap area shall be placed on top of a geotextile barrier to maintain separation from the underlying ground surface, and shall be covered to minimize contact with precipitation.
- G. Prior to excavation, Work areas shall be surrounded by soil berms, or other approved measures, to contain surface water runoff accumulation within the Work areas, and to exclude surface water run-on from adjacent areas. The CONTRACTOR shall employ excavation methods that minimize the need to remove accumulated water from excavations. However, if unavoidable, accumulated water shall be disposed by methods specified in Section 02402 of these Technical Specifications. Control of surface water shall be by methods referenced in Article 3.03 of Section 02125 of these Specifications.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 LIMITS OF EXCAVATION

- A. **Stability of Excavations.** Excavation side slopes shall comply with federal, state and/or local codes and ordinances having jurisdiction. Shore and brace, in accordance with Section 02150, where sloping is not possible due to space restrictions, where there is a requirement to minimize refuse disturbance, and/or where instability of excavated material is possible. The CONTRACTOR shall comply with all applicable OSHA and other related safety requirements. Maintain excavation side slopes in a safe condition, until completion of backfilling.

- B. Additional Excavation. When excavation has reached required subgrade elevations, notify QAO who will make a review of conditions. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations to develop suitable bearing and replace excavated material as directed by the GROUP's REPRESENTATIVE or QAO.
- C. Unauthorized excavations consist of removal of materials beyond subgrade elevations indicated on Contract Documents or dimensions without specific direction by the GROUP's REPRESENTATIVE or QAO. Unauthorized excavations shall be remedied by the CONTRACTOR at the CONTRACTOR's sole expense. The CONTRACTOR shall backfill and compact unauthorized excavations in the same manner as specified for authorized excavations of same classification at the CONTRACTOR's sole expense, unless otherwise directed by the GROUP's REPRESENTATIVE.

3.02 STOCKPILES

- A. Stockpile excavated materials where directed by GROUP's REPRESENTATIVE, until properly disposed off-Site or used as backfill and fill in accordance with Section 02223 of these Technical Specifications. Place, grade, shape, and maintain stockpiles to provide proper drainage. Cover and install appropriate erosion and sediment control devices, in accordance with Section 02125, around stockpiles when requested by QAO and/or GROUP's REPRESENTATIVE.
- B. Provide and maintain separate stockpiles for riprap, cover soils, refuse, grading fill, topsoil, drainage stone, and other specified materials.
- C. Locate and retain stockpiled materials at least fifteen (15) feet away from edge and upslope of all excavations, or further as determined by the CONTRACTOR, so that the weight of the stockpiled materials will not create excessive loading conditions on excavation edges, shoring and bracing, and underground piping.
- D. All stockpiles of excavated materials shall be protected against excess dust and odor generation and vectors. Refuse stockpiles shall receive one (1) foot of soil cover or other satisfactory cover to minimize odor, blowing litter, and contact with precipitation. Stockpile covers shall be secured and held in place with sand bags, tires, nets, or equivalent, such that precipitation does not enter the stockpiles, and wind will not expose the stockpiles.
- E. Control of dust and odors from stockpiles shall be in accordance with Sections 01562 and 01563 of these Technical Specifications.
- F. Utilize excess material and waste materials in accordance with Section 02223 of these Technical Specifications for materials meeting the requirements of fill, and

Section 02221 of these Technical Specifications for material not meeting the requirements of fill.

3.03 EXCAVATION INSTRUCTIONS

- A. Excavation for Structures: Conform to elevations and dimensions required within a tolerance of plus or minus 0.10 feet, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
- B. Excavation for Trenches: Excavate trenches to the minimum widths required for particular items to be installed. Slope or bench the sides of trenches greater than 4-foot-deep in accordance with OSHA 1926 (Subpart P) requirements and other applicable regulations. Provide appropriate access (ladders, etc.) at minimum frequencies specified in these regulations. Trenches shall be sufficiently wide to provide ample working room and as otherwise required for proper installations. All trench excavations shall be sufficiently wide to accommodate mechanical compaction equipment (minimum 6 inches) on both sides of pipes.
 - 1. Excavated trenches with depths greater than four (4) feet shall be considered confined spaces and shall be excavated and utilities installed in conformance with the requirements of the CONTRACTOR's Site-specific Health and Safety Plan prepared in accordance with Section 01564 of these Specifications.
 - 2. All excavated materials shall be removed and hauled from the Work areas at the time of excavation, and stockpiled for reuse as backfill at designated on-Site areas or disposed, at the CONTRACTOR's expense, as directed by the GROUP'S REPRESENTATIVE or QAO.
 - 3. Barricades and signs warning of open trench excavations shall be erected to protect personnel working in the area.
 - 4. Excavate trenches to the depths indicated on the Contract Documents or as required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations.
 - 5. Where unsuitable bedding subgrade surface is encountered, over-excavate six (6) inches and backfill with specified bedding material prior to installation of bedding and pipe. All visible sharp protruding objects shall be removed or covered with a minimum of twelve (12) inches of compacted fill prior to placement of pipes or other structures.
 - 6. Bedding and backfilling shall be in accordance with Section 02223 of these Specifications.
 - 7. Do not backfill trenches until tests and inspections have been made, record surveying has been performed, and backfilling has been authorized by the QAO. The CONTRACTOR shall use care in backfilling to avoid damage or displacement of pipe systems.

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- C. Following the excavation for swales, channels, concrete structures, outlets, outfalls, pipes, aprons, etc., the CONTRACTOR shall re-grade and add compacted backfill as needed to achieve the required surface for placement of materials as shown on the Contract Drawings, or as otherwise required by the Contract Documents.

*****END OF SECTION*****

SECTION 02221

SOIL AND WASTE DISPOSAL

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall furnish all labor, materials, equipment, tools and appurtenances required to complete the Work of this Section. The CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect the Work.
- B. Comply with all applicable codes, ordinances, rules, regulations and laws of local, State, and Federal authorities having jurisdiction. Comply with Section 02220 of these Specifications for excavations as applicable.
- C. The Work includes, but is not limited to:
 - 1. Excavation of existing waste, which require cut, trenching, and/or drilling, to establish subgrade elevations, minimum or maximum grades, or the installation of an enhanced groundwater extraction system prior to the placement of the cap system;
 - 2. Removal of incidental waste from areas outside the capped area as directed by the GROUP's REPRESENTATIVE, including refuse, drums, fencing, and investigation derived wastes (IDW) from within and around the landfill and any proposed staging areas;
 - 3. Placement of waste and cover materials removed from the excavation areas in designated waste relocation areas on the Site;
 - 4. Compaction of waste and soils in the waste relocation areas; and,
 - 5. Placement and maintenance of temporary cover in the waste relocation areas until the 12-inch grading layer is placed.
- D. The CONTRACTOR shall place temporary cover soil on any areas of exposed waste where additional activities are not planned for overnight. The extent of exposed waste areas requiring temporary cover shall be minimized. The CONTRACTOR may also use a synthetic tarp or other appropriate cover material approved by the GROUP's REPRESENTATIVE to temporarily cover the waste. The CONTRACTOR shall implement appropriate erosion and sediment controls around stockpiles in accordance with Section 02125 of the Specifications.
- E. The CONTRACTOR shall continuously monitor ambient air for the presence of explosive or hazardous gases during waste excavation activities in accordance with the CONTRACTOR's Health and Safety Plan, as required by Section 01564 of these Technical Specifications.

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1.02 RELATED SECTIONS

- A. 01562 – Dust Control
- B. 01563 – VOC, Odor, Vector and Spill Control
- C. 01564 – Health and Safety
- D. 02110 – Site Clearing and Grubbing
- E. 02125 – Erosion and Sediment Control
- F. 02150 – Shoring and Bracing
- G. 02210 – Site Grading
- H. 02220 – Excavation
- I. 02223 – Backfill and Fill
- J. 02402 – Liquids Handling and Disposal

1.03 DEFINITIONS

- A. Waste: Waste, debris and existing cover materials are the end product of historic operations that took place in the area and soils used for cover. All personnel associated with intrusive activities shall be trained in accordance with OSHA HAZWOPER (29 CFR 1910.120) and be familiar with the CONTRACTOR's Site-specific Health and Safety Plan prepared in accordance with Section 01564 of these Technical Specifications.
- B. Waste, debris, and existing cover materials, which are excavated/removed to attain subgrade elevations, may be relocated and placed in areas requiring fill to attain subgrade elevations.
- C. Waste, debris, and existing cover materials that are excavated in quantities greater than those quantities required to attain subgrade elevations, may be placed as fill at designated on-Site locations, as directed by the REMEDIAL DESIGNER. Such areas shall be graded, as directed by the REMEDIAL DESIGNER, to meet minimum and maximum slope requirements.
- D. Restrictions
 - 1. Waste, or soil containing waste, shall not be placed within the upper 12-inch-thick grading layer immediately below the cap geosynthetics.
 - 2. Excavated waste, debris, and existing cover materials shall not be used for components of the Work requiring general, grading, or structural fill in accordance with Section 02223 of these Technical Specifications and as shown on the Contract Drawings.

1.04 SUBMITTALS

- A. Waste Excavation and Relocation Plan: Prior to performing any subgrade preparation or excavation on-Site, the CONTRACTOR shall prepare and submit a Waste Excavation and Relocation Plan to the REMEDIAL DESIGNER for review. At a minimum, this Plan shall indicate, but not limited to, the following: proposed sequences for removing existing cover materials; excavating waste; equipment to be used; approximate waste quantities; operational procedures such as hauling routes, placement, and compaction; procedures for managing and controlling surface water run-on and run-off; procedures for controlling, collecting, storing, and disposing any liquids encountered; procedures for

controlling and mitigating odor, fugitive dust, and blowing litter; procedures and materials to be used for temporary cover over exposed waste; and health and safety protocols. This Plan shall also specifically identify areas where waste excavation is expected and where excavated waste will be placed and show how areas of exposed waste at both excavation and fill areas will be minimized at all times. The Plan shall also provide details and plan drawings for temporary surface water run-on and run-off control features, and typical operations for waste excavation and temporary cover placement over exposed waste areas. The Plan shall also include contingency procedures for handling of any drums or liquids that may be encountered, including monitoring requirements, overpacking methods, and procedures for control, collection, and disposal of liquids.

- B. Submit in accordance with Section 01300 of these Technical Specifications.

1.05 HEALTH AND SAFETY REQUIREMENTS

- A. Work shall be performed in compliance with all applicable health and safety regulations and in accordance with the CONTRACTOR's site-specific Health and Safety Plan.
- B. The CONTRACTOR shall continuously monitor ambient air for the presence of explosive or hazardous gases during waste excavation operations. Concentrations shall be maintained with acceptable limits as listed in the CONTRACTOR's site-specific Health and Safety Plan. If gas concentrations exceed allowable limits, construction activities shall be immediately discontinued until such time as safe conditions exist.

1.06 FIELD MEASUREMENTS

- A. Verify that survey benchmarks and intended elevations for the Work are as indicated.

PART 2 - PRODUCTS

2.01 TEMPORARY COVER

- A. Temporary cover is material used for covering of the waste and soils placed in waste relocation areas and in areas of newly exposed waste. Cover soil shall meet the requirements for grading fill in accordance with Section 02223 of these Specifications.
- B. Alternative cover materials such as tarps may be proposed by the CONTRACTOR and shall require favorable review by the GROUP's REPRESENTATIVE prior to use.

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PART 3 - EXECUTION

3.01 PREPARATION OF WASTE EXCAVATION AND RELOCATION AREAS

- A. Identify required lines, grades, contours, and datum.
- B. Protect benchmarks and existing structures from excavation equipment and vehicular traffic.
- C. The CONTRACTOR shall designate an Exclusion Zone (impacted area), Decontamination Zone and Support Zone (clean area) prior to the commencement of the excavation of areas in waste. An Exclusion Zone delineated by a tape barrier, or equivalent marker, shall be established in a minimum 25-foot-radius around the areas to be excavated. All personnel entering the Exclusion Zone shall wear the required PPE and shall decontaminate immediately upon leaving the Exclusion Zone, as described in the CONTRACTOR's site-specific Health and Safety Plan.
- D. The CONTRACTOR shall conduct air monitoring within and around all areas of exposed waste in accordance with the CONTRACTOR's site-specific Health and Safety Plan. The CONTRACTOR shall cease operations, evacuate all personnel, and immediately cover the exposed waste in areas where the action levels are exceeded as defined in the CONTRACTOR's site-specific Health and Safety Plan.

3.02 EXCAVATION

- A. Maintain excavation area dry. Grade top perimeter of excavation to prevent surface water from draining into the excavation.
- B. In all areas requiring trenching or excavation of waste, such as construction of the gas collection trench, the CONTRACTOR is responsible for following all applicable health and safety precautions.
- C. In areas requiring cut for cap placement, excavate to subgrade elevation of the landfill cap section as shown on the Contract Drawings prior to placement of grading fill in accordance with Section 02223.
- D. Notify the QUALITY ASSURANCE OFFICER (QAO) in advance so that the excavated area can be observed.
- E. Notify the QAO of unexpected subsurface conditions and discontinue affected Work in the area until notified to resume.
- F. Keep all transportation equipment, roads, and traffic areas free of debris and/or waste.
- G. Collect and control water encountered in excavations and disposed in accordance with Section 02402.

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- H. Cover all areas of exposed wastes daily using a 6-inch-thick daily grading fill, temporary tarps, or other cover materials favorable reviewed by the GROUP's REPRESENTATIVE.

3.04 PLACEMENT OF EXCAVATED WASTE

- A. Place excavated waste and soils in areas requiring subgrade fill as indicated on the Contract Drawings, or as directed by the REMEDIAL DESIGNER.
- B. Excavated waste and soils shall not be placed until the subgrade has been inspected in place and favorably reviewed by the QAO.
- C. Mix debris and waste, as necessary, with other on-Site soil requiring disposal, or clean off-Site borrow soils, to achieve a consistency to satisfy the compaction requirements described in Article 3.05 herein.
- D. Stumps, trunks, or other large land clearing debris shall not be buried on-Site, and shall be handled in accordance with Section 02110 of these Specifications.
- E. Employ a placement method that does not disturb or damage other portions of the Work or work by others.
- F. Make gradual grade changes blending slopes into surrounding areas.
- G. Surface water run-on and run-off control, and erosion and sediment control shall be performed in accordance with Section 02125 of these Specifications.
- I. Cover all areas of exposed wastes daily using a 6-inch-thick daily grading fill, temporary tarps, or other cover materials favorable reviewed by the GROUP's REPRESENTATIVE.

3.05 COMPACTION OF EXCAVATED WASTE AND SOILS

- A. Prior to waste placement in areas requiring fill, compact areas by proof-rolling in accordance with Section 02223 of the Specifications. Waste placement shall not be performed on an area that has not been proof-rolled.
- B. Excavated waste and debris shall be blended with on-site soils, or off-site soils, and shall be placed in loose lifts not exceeding twelve (12) inches in thickness. Compaction shall be performed by a minimum 20-ton roller vibratory compact, or approved equivalent method. The CONTRACTOR shall make a minimum of three (3) one-way passes per lift with the roller over all areas. The compacted surface shall appear smooth and stable. Areas which exhibit an unstable condition, such as excessive pumping, movement, or sloughing during compaction, shall be reworked and compacted as necessary at the CONTRACTOR's expense. The compacted surface of each shall be favorably reviewed by the QAO prior to placement of additional lifts.

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3.06 PROTECTION OF FINISHED WORK

- A. After subgrade elevations shown on the Contract Drawings are achieved, place clean grading fill to a minimum thickness of twelve (12) inches over all areas to receive the landfill cap system.

3.07 FIELD QUALITY CONTROL

- A. Provide for visual inspection of excavated surfaces, lift thickness, and compaction procedures.

3.08 DECONTAMINATION

- A. All equipment used for the excavation, stockpiling, and/or conveyance of waste materials shall undergo decontamination in accordance with the CONTRACTOR's site-specific Health and Safety Plan.

*****END OF SECTION*****

SECTION 02223

BACKFILL AND FILL

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall furnish all labor, equipment, tools and appurtenances required to complete portions of the Work requiring backfill and fill. The Work of this Section includes the acquisition, placement, grading, and compaction of backfill and fill materials, and other related and incidental Work within the designated areas, and as required, for the construction of other Work, as shown, specified, or required by the Contract Documents.
- B. The CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations and laws of local, State, and Federal authorities having jurisdiction. The CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect the Work.
- C. The CONTRACTOR is responsible for following all Health and Safety precautions applicable to trenches during backfilling of trenches.

1.02 RELATED SECTIONS

- A. 01050 – Field Engineering/Surveying
- B. 02100 – Site Preparation
- C. 02110 – Site Clearing and Grubbing
- D. 02125 – Erosion and Sediment Control
- E. 02150 – Shoring and Bracing
- F. 02210 – Site Grading
- G. 02220 – Excavation
- H. 02221 – Soil and Waste Disposal
- I. 02224 – Cover Soil
- J. 02225 – Vegetative Support Layer
- K. 02595 – Geotextiles

1.03 PROTECTION OF PEOPLE AND PROPERTY

- A. The CONTRACTOR shall plan and execute the Work so as to prevent damage to existing structures, safeguard people and property, minimize traffic inconvenience, protect structures to be installed, and provide safe working conditions.

- B. Work shall be performed in accordance with all applicable health and safety and OSHA regulations and in accordance with the CONTRACTOR's Site-specific Health and Safety Plan.

PART 2 – PRODUCTS

2.01 GENERAL

- A. No frozen materials shall be used for backfill, fill, or any other materials specified herein. All fill and backfill materials shall be free from organic materials, wood, trash, broken concrete, masonry rubble, shells, and all deleterious and objectionable materials which may be degradable or which cannot be properly compacted. Backfill and fill materials shall not contain rock fragments greater than the maximum dimensions specified in Articles 2.02 through 2.04 herein, as appropriate for the intended use. Backfill and fill materials shall have physical properties such that they can be readily spread and compacted. Snow, ice, and frozen soil shall be removed from fill and backfill material prior to placement.
- B. All imported fill materials shall be obtained from off-Site deposits of natural geologic materials. Recycled and/or reprocessed materials shall not be used on-Site. In addition, mixtures of recycled/reprocessed and natural materials shall not be use on-Site. Specifically, recycled/reprocessed materials shall include, but not be limited to, recycled concrete and bituminous concrete materials.
- C. Spoils from trench excavations may be used as backfill and fill, provide said excavated materials satisfy the requirements herein. If these excavated materials do not satisfy the requirements specified herein, said materials may only used with the REMEDIAL DESIGNER approval.
- D. The CONTRACTOR shall certify that all imported off-Site materials are environmentally clean, in accordance with N.J.A.C. 7:26E, and shall provide analytical test results to support these certifications. The GROUP may elect to perform additional analytical testing, at its own cost, of samples obtained from the CONTRACTOR's off-Site source to verify that the material is environmentally clean. The CONTRACTOR shall cooperate with the GROUP in obtaining samples for this purpose. The GROUP may reject any sources proposed by the CONTRACTOR based on analytical test results or past history of the source of the material.
- E. Any imported materials from off-Site borrow sources found to not be in accordance with the Specifications, or found to be contaminated, shall immediately be removed and replaced with suitable materials at the CONTRACTOR's sole expense with no time extensions in the Construction

Schedule granted. Costs associated with the QAO's effort to comply with the CQAP for this replacement effort shall be borne by the CONTRACTOR as well.

2.02 GRADING FILL

- A. CONTRACTOR may elect to utilize excavated on-Site waste materials as grading fill, provided it satisfies the gradation requirements identified below or as approved by the REMEDIAL ENGINEER.
- B. All imported grading fill materials shall be environmentally clean soil, in accordance with N.J.A.C. 7:26E, from an off-Site borrow source(s) approved by the GROUP's REPRESENTATIVE, QUALITY ASSURANCE OFFICER (QAO), and REMEDIAL DESIGNER. All borrow materials intended for use as grading fill shall be free of shells, organic matter, and deleterious materials.
- C. All grading fill materials shall meet the following gradation requirements:

U.S. Standard Sieve	Percent Passing by Weight
1½ inch	100
¾ inch	95-100
No. 4	70-95
No. 20	20-70
No. 200	0-20

- D. Prior to placement of grading fill materials, CONTRACTOR shall perform and submit results of all requisite gradation and compaction testing, which shall be performed in accordance with ASTM D422 and D698, respectively.
- E. CONTRACTOR shall submit to the OWNER's REPRESENTATIVE, QAO, and REMEDIAL DESIGNER all laboratory-testing results for gradation and compaction testing performed. All gradation and compaction testing shall be performed on representative bulk samples from each borrow source providing grading fill materials, and for all grading fill materials found to be materially different.

2.03 SAND FILL AND SAND BEDDING

- A. All imported sand fill and sand bedding materials shall be environmentally clean soil, in accordance with N.J.A.C. 7:26E, from an off-Site borrow source(s) approved by the GROUP's REPRESENTATIVE, QAO, and REMEDIAL DESIGNER. All borrow materials intended for use as sand fill and sand bedding shall be free of shells, organic matter, and deleterious materials.
- B. All sand fill and sand bedding materials shall meet the following gradation requirements:

U.S. Standard Sieve	Percent Passing by Weight
3/8-inch	100
No. 4	95-100
No. 20	80-95
No. 40	50-80
No. 100	10-50
No. 200	0-10

- C. Prior to placement of sand fill and sand bedding materials, CONTRACTOR shall perform and submit results of all requisite gradation and compaction testing, which shall be performed in accordance with ASTM D422 and D698, respectively.
- D. CONTRACTOR shall submit to the OWNER's REPRESENTATIVE, QAO, and REMEDIAL DESIGNER all laboratory-testing results for gradation and compaction testing performed. All gradation and compaction testing shall be performed on representative bulk samples from each borrow source providing sand fill and sand bedding materials, and for all sand fill and sand bedding materials found to be materially different.

2.04 STRUCTURAL FILL

- A. All imported structural fill shall be environmentally clean soil, in accordance with N.J.A.C. 7:26E, from an off-Site borrow source(s) approved by the GROUP's REPRESENTATIVE, QAO, and REMEDIAL DESIGNER. All borrow materials intended for use as structural fill shall be composed of naturally occurring or processed soil and/or gravel materials, and shall be free of shells, organic matter, and deleterious materials.
- B. All structural fill materials shall meet the following gradation requirements:

U.S. Standard Sieve	Percent Passing by Weight
1½ inch	100
¾ inch	95-100
No. 4	60-95
No. 40	15-60
No. 200	0-15

- E. Prior to placement of structural fill materials, CONTRACTOR shall perform and submit results of all requisite gradation and compaction testing, which shall be performed in accordance with ASTM D422 and D698, respectively.
- F. CONTRACTOR shall submit to the OWNER's REPRESENTATIVE, QAO, and REMEDIAL DESIGNER all laboratory-testing results for gradation and compaction testing performed. All gradation and compaction testing shall be

performed on representative bulk samples from each borrow source providing structural fill materials, and for all structural fill materials found to be materially different.

PART 3 – EXECUTION

3.01 PRECAUTIONS

- A. Backfill and fill shall not be placed using frozen materials. Previously placed backfill which has become frozen shall be removed and replaced, or otherwise recompacted after thawing has occurred, as approved by the QAO.
- B. Backfill and fill materials shall not be placed over snow, ice, standing water, or on subgrade which is excessively moist, dry, cracked, rutted, or loose.

3.02 STORAGE

- A. Stockpile excavated and imported materials where directed by the GROUP's REPRESENTATIVE until required for backfill and fill placement. Place, grade and shape stockpiles to provide proper drainage. Seal stockpiles with a smooth drum roller to avoid excessive moisture retention. Install appropriate erosion and sediment control devices around stockpiles.
- B. Locate and retain stockpiled soil materials in a location where the weight of the stockpiled materials will not create surcharge loading conditions on the edges of excavations as specified in Section 02220.

3.03 PLACEMENT OF FILL

- A. Fill materials shall not be placed until the subgrade has been inspected in-place, surveyed, and favorably reviewed by the QAO.
- B. Subgrade shall be proof-rolled prior to the placement of fill materials. Proof-rolling shall be performed with minimum twenty (20) ton vibratory roller, or other method favorably reviewed by the QAO. Unstable or unsuitable soil, as determined by the QAO during by proof-rolling, shall be removed and replaced with grading fill or structural fill.
- C. Employ a placement method which does not disturb or damage other completed Work.
- D. Make gradual grade changes. Blend slope into surrounding areas.

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- E. Place backfill and fill in relatively uniform horizontal lifts not exceeding eight (8) inches before compaction, or as shown on the Contract Drawings. Compact each lift as required by Article 3.05.
- F. The tolerance for layers having a specified minimum thickness shall be -0.0 to +0.1 feet of the specified thickness. The CONTRACTOR shall ensure that materials placed meet or exceed the minimum specified thickness, but do not exceed maximum thicknesses, as required by the Contract Documents.

3.04 BACKFILL OF TRENCHES

- A. Backfill shall not be placed in trenches until pipe installation and related Work has been favorably reviewed by QAO and the appropriate survey has been performed by the CONTRACTOR in accordance with Section 01050 of these Specifications. The CONTRACTOR shall comply with the following trench backfill procedures:
 - 1. Pipes shall be bedded and backfilled as required or as directed by the QAO and shown on the Contract Drawings. Care shall be taken to place and compact bedding material under pipe haunches to ensure continuous contact with, and support of, the pipe.
 - 2. All trenches shall be backfilled as soon as possible after the pipes have been installed to assure protection against damage.
 - 3. Backfill shall be placed to the required elevations as shown on the Contract Drawings.
 - 4. Trench bedding and backfill materials shall be placed in uniform lifts of 6-inch maximum loose thickness. Compact each lift as required by Article 3.05. The method of compaction shall not damage the pipes. Each layer shall be compacted and tested as required by Article 3.05 before the next layer is placed.

3.05 COMPACTION REQUIREMENTS

- A. Backfill and fill shall be placed and compacted to achieve a minimum density of ninety (90) percent of its maximum dry density and within plus or minus two (2) percent of its optimum moisture content, as determined by ASTM D698.
- B. Care shall be taken not to damage any piping or other buried utilities during proof-rolling, placement, and compaction activities.
- C. "Puddling" or "jetting" methods of compaction shall not be permitted.

3.06 FIELD QUALITY ASSURANCE/CONTROL

- A. The QAO shall perform compaction testing of each lift of backfill and fill in accordance with the Construction Quality Assurance (CQA) Plan. Any areas

that do not meet the requirements specified herein shall be reworked by the CONTRACTOR by providing additional compaction effort until acceptable test results are obtained. The CONTRACTOR shall not proceed with a new lift of material until the QAO has confirmed that the previous lift has attained the required compaction. The CONTRACTOR shall rework by wetting, drying, or recompacting backfill/fill material that is not in compliance with the compaction and moisture content requirements of this section. At his sole expense, the CONTRACTOR may remove and replace fill materials with prior approval from the QAO.

- B. In areas where the degree of compaction is not obtained or the uniformity of materials is not maintained in the opinion of the QAO, additional tests and/or compactive effort will be made by the CONTRACTOR, as directed by the QAO, at no additional cost to the GROUP.
- C. The CONTRACTOR shall be responsible for conducting any and all quality control testing necessary for the CONTRACTOR's purposes to satisfy the Contract Documents.

3.07 SURVEY CONTROL AND TOLERANCES FOR GRADING FILL LAYER

- A. The completed subgrade surface shall be surveyed, as necessary, to ensure that grades are in accordance with the Contract Drawings.
- B. Survey completed subgrade on a 50-foot-square grid and at all grade breaks, and limits of cut/fill. For channels, survey cross sections every fifty (50) feet along the channel and at all changes in slope.
- C. Acceptable tolerances shall be ± 0.1 feet on survey elevations and ± 0.1 feet on survey coordinates.
- D. The survey results shall be certified by a surveyor licensed and registered in the State of New Jersey in the employ of, or subcontracted to, the CONTRACTOR and meet the requirement of Section 01050 of these Specifications.
- E. The CONTRACTOR shall certify that the subgrade meets the requirements of the Contract Documents and submit the record survey drawing of the completed subgrade to the QAO.

*****END OF SECTION*****

SECTION 02224

COVER SOIL

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. CONTRACTOR shall furnish all labor, equipment, tools and appurtenances required to complete the cover soil component of the landfill cap. The Work of this Section includes the excavation, loading, hauling, placement, grading, stockpiling, and compaction of cover soil, and other related and incidental work within the designated areas and as required for the construction of other work, as shown, specified, or required by the Contract Documents.
- B. CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations and laws of local, State, and Federal authorities having jurisdiction. CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect the Work.

1.02 RELATED SECTIONS

- A. 01050 – Field Engineering/Surveying
- B. 02100 – Site Preparation
- C. 02125 – Erosion and Sediment Control
- D. 02210 – Site Grading
- E. 02223 – Backfill and Fill
- F. 02225 – Vegetative Support Layer
- G. 02590 – Geomembranes
- H. 02595 – Geotextiles
- I. 02599 – Geocomposite Drainage Layer

1.03 DEFINITIONS

- A. Cover soil is defined as the material placed directly above the previously installed geocomposite drainage layer.

1.04 PROTECTION OF PEOPLE AND PROPERTY

- A. CONTRACTOR shall plan and execute the Work so as to prevent damage to the underlying geosynthetic components of the landfill cap system. CONTRACTOR shall protect existing structures, safeguard people and property, minimize traffic inconvenience, protect structures to be installed, and provide safe working conditions.

- B. Work shall be performed in accordance with all applicable health and safety and OSHA regulations, and in accordance with CONTRACTOR's Site-specific Health and Safety Plan.

PART 2 – PRODUCTS

2.01 GENERAL

- A. No frozen materials shall be used for cover soil. Cover soil shall be free from organic materials, wood, trash, shells, broken concrete, masonry rubble, and all deleterious and objectionable materials which may be degradable or which cannot be properly compacted. Cover soil shall not contain rock fragments greater than the maximum dimensions specified in Article 2.02. Cover soil shall have physical properties such that it can be readily spread and compacted. Snow, ice, and frozen soil shall be removed from cover soil material prior to placement.
- B. A Synthetic Precipitation Leaching Procedure (SPLP) test shall be run on the fill materials prior to use on-site. The SPLP will be run using a solution with pH of 4.5. The pH of the resulting leachate will be tested to verify the pH is within the range of 4.5 to 8.5.
- C. All imported fill materials shall be obtained from off-Site deposits of natural geologic materials. Recycled and/or reprocessed materials shall not be used on-Site. In addition, mixtures of recycled/reprocessed and natural materials shall not be use on-Site. Specifically, recycled/reprocessed materials shall include, but not be limited to, recycled concrete and bituminous concrete materials.
- D. The CONTRACTOR shall certify that the off-Site materials are environmentally clean, in accordance with N.J.A.C. 7:26E, and shall provide analytical test results to support this certification. The GROUP may elect to perform additional analytical testing, at its own cost, of samples obtained from the CONTRACTOR's off-Site source to verify that the material is environmentally clean. The CONTRACTOR shall cooperate with the GROUP in obtaining samples for this purpose. The GROUP may reject any sources proposed by the CONTRACTOR based on analytical test results or past history of the source of the material.
- E. Any imported materials from off-Site borrow sources found to not be in accordance with the Specifications, or found to be contaminated, shall immediately be removed and replaced with suitable materials at the CONTRACTOR's sole expense with no time extensions in the Construction Schedule granted. Costs associated with the QAO's effort to comply with the CQAP for this replacement effort shall be borne by the CONTRACTOR as well.

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- F. CONTRACTOR shall submit its proposed sequences and methods, including descriptions of all compaction equipment, for the placement and compaction of all specified cover soil materials

2.02 COVER SOIL

- A. All cover soils shall be environmentally clean soil, in accordance with N.J.A.C. 7:26E, from an off-Site borrow source(s) approved by the GROUP's REPRESENTATIVE, QAO, and REMEDIAL DESIGNER. All borrow materials intended for use as cover soil shall be free of shells, organic matter, and deleterious materials.

- B. All cover soil materials shall meet the following gradation requirements:

U.S. Standard Sieve	Percent Passing by Weight
1½ inch	100
¾ inch	95-100
No. 4	75-95
No. 20	20-75
No. 200	0-20

- C. Prior to placement of cover soil materials, CONTRACTOR shall perform and submit results of all requisite gradation testing, which shall be performed in accordance with ASTM D422.
- D. CONTRACTOR shall also perform and submit direct shear testing results to demonstrate that the compacted, in-place cover soil materials exhibit a minimum internal friction angle of twenty-five (25) degrees. All direct shear testing shall be performed on compacted specimens in accordance with ASTM D3080. Given the degree of compaction effort is dependent on the CONTRACTOR's proposed equipment and methods, CONTRACTOR shall prepare all direct shear test specimens utilizing similar methods and compaction effort to those implemented in the field (i.e., CONTRACTOR shall be required to establish target unit weights and moisture contents for all direct shear test specimens, and said target unit weights and moisture contents shall be representative of actual field conditions).
- E. CONTRACTOR shall submit to the OWNER's REPRESENTATIVE, QAO, and REMEDIAL DESIGNER all laboratory-testing results for pH, gradation and direct shear testing performed. All gradation and direct shear testing shall be performed on representative bulk samples from each borrow source providing cover soil materials, and for all cover soil materials found to be materially different.

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PART 3 – EXECUTION

3.01 PRECAUTIONS

- A. Cover soil shall not be placed using frozen materials. Previously placed cover soil that has become frozen shall be removed and replaced, or otherwise recompacted after thawing has occurred, as approved by the QAO.
- B. Cover soil shall not be placed over snow, ice, standing water, or on a previous lift which is excessively moist, dry, cracked, rutted, or loose.

3.02 STORAGE

- A. Stockpile satisfactory excavated and imported materials where directed by the GROUP's REPRESENTATIVE until required for placement. Place, grade and shape stockpiles to provide proper drainage. Seal stockpiles with a smooth drum roller to avoid excessive moisture retention. Install appropriate erosion and sediment control devices around stockpiles.
- B. Locate and retain stockpiled soil materials in a location where the weight of the stockpiled materials will not create surcharge loading conditions on the edges of excavation as specified in Section 02220 of these Specifications.

3.03 PLACEMENT

- A. Construct the cover soil to the minimum thicknesses, elevations, and limits shown in the Contract Documents. Place cover soil materials in two (2) lifts, such that the compact cover soil layer achieves the minimum thicknesses indicated in the Contract Documents.
- B. Spread cover soils over the underlying geocomposite drainage layer utilizing all appropriate means and methods that will not introduce tensile forces or cause damage to said geocomposite drainage layer and/or the underlying geomembrane and GCL. Cover soil materials shall be placed starting at toes-of-slope and precede upslope.
- C. The initial loose lift thickness of cover soil shall not be less than twelve (12) inches and not more than fourteen (14) inches. Compact cover soil uniformly by tracking over its entire surface utilizing low ground pressure construction equipment in a manner acceptable to the QAO. Compaction equipment and methods shall not cause damage to the installed geomembrane, GCL, and geocomposite drainage layers.
- D. The second lift of cover soil shall have a maximum loose thickness of eight (8) inches, and it shall be uniformly compacted utilizing the same compaction equipment and methods used for the initial lift of cover soil materials. Place and

compact the second layer, as necessary, to achieve the minimum thicknesses indicated in the Contract Documents.

- E. In any area where compaction is to be performed using hand-operated equipment, place soil cover materials with a maximum loose thickness of four (4) inches.
- F. Do not operate any construction equipment directly on any geosynthetic layers, unless appropriate protection measures are implemented and the manner of protection is acceptable to the QAO. Take all necessary precautions to prevent damage to the underlying geosynthetic layers, during the installation of protective measures.
- G. Heavy equipment and trucks shall not be allowed to travel on the cover soil layer, except on temporary roadways constructed to the limits and minimum thickness as listed below based on the ground pressure of the equipment or vehicles:

Maximum Allowable Equipment Ground Pressure (pounds per square inch (psi))	Minimum Thickness of Overlying Material (inches)
<5	12
5-10	18
10-20	24
>20	36

- H. CONTRACTOR shall place all soil cover materials such that:
 - 1. The underlying geosynthetic materials are not damaged;
 - 2. No slippage occurs between the geosynthetic layers; and
 - 3. Excessive tensile stresses are not produced in geosynthetic layers.
- I. Do not place cover soil over geosynthetic layers when the ambient temperature is below 40°F or above 104°F, unless authorized by the QAO.
- J. Do not place cover soil over geosynthetic layers which have excessive wrinkles or on areas of “bridging” or “trampolining” (i.e. where the geosynthetic layer is not in direct contact with the underlying soil surface such as at the toe of slope or other abrupt change in grade). A wrinkle is considered unacceptable when it can be folded over onto itself. Bridging is considered unacceptable if more than a 12-inch width of the geosynthetic layer is not in contact with the underlying soil surface. The CONTRACTOR may wait until ambient conditions change such that the wrinkles or areas of bridging are reduced to acceptable size as defined herein. Otherwise, unacceptable wrinkles or areas of bridging shall be repaired and tested in accordance with the requirements of Section 02590 of these Specifications. In no case shall the cover soil be placed over unacceptable wrinkles or areas of

bridging which could result in overstressing of the geosynthetic layers as determined by the QAO.

3.04 FIELD QUALITY ASSURANCE/CONTROL

- A. The QAO shall obtain samples for laboratory testing and shall perform thickness measurements of the cover soil as required by the CQA Plan. The CONTRACTOR shall cooperate with and assist the QAO with sampling and thickness measurements, as necessary, to meet the requirements of the CQA Plan. The CONTRACTOR shall remediate the cover soil layer as indicated by testing or field measurements, to the satisfaction of the QAO.
- B. The CONTRACTOR shall be responsible for conducting any and all quality control testing necessary for CONTRACTOR's purposes to satisfy the Contract Documents. The CONTRACTOR shall ensure that materials placed do not exceed maximum thicknesses as required by the Contract Documents.

3.05 SURVEY CONTROL AND TOLERANCES

- A. Survey the limits and elevation of the top of the cover soil in accordance with Section 01050.
- B. Construct the cover soil to within plus or minus 0.1 feet of the thickness shown on the Contract Drawings.
- C. Construct the cover soil to maintain the minimum and maximum slopes as indicated on the Contract Drawings.

*****END OF SECTION*****

SECTION 02225

VEGETATIVE SUPPORT LAYER

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall furnish all labor, materials, equipment, tools and appurtenances required to complete portions of the Work requiring the placement of a vegetative support layer. The work of this Section includes the acquisition, placement, and grading of the vegetative layer material, material handling, and other related and incidental work within the designated areas and as required for the construction of other work, as shown, specified, or required by the Contract Documents.
- B. The CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations and laws of local, municipal, State, and Federal authorities having jurisdiction. The CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect the Work.
- C. The CONTRACTOR shall be responsible for procuring off-Site borrow sources for vegetative support layer material needed for construction of the cap. However, a portion of this material may be available from on-site and off-site borrow sources provided by the GROUP. The CONTRACTOR shall perform investigations to determine the quantity of material available from off-site sources provided by the GROUP, as well as additional sources identified by the CONTRACTOR, to provide a sufficient quantity of vegetative support soil for the cap.

1.02 RELATED SECTIONS

- A. 01050 – Field Engineering/Surveying
- B. 02100 – Site Preparation
- C. 02125 – Erosion and Sediment Control
- D. 02210 – Site Grading
- E. 02223 – Backfill and Fill
- F. 02224 – Cover Soil

1.03 DEFINITIONS

- A. Vegetative support layer is defined as the uppermost 6-inch-thick soil layer component of the landfill cap, and shall be capable of supporting vegetation.

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1.04 PROTECTION OF PEOPLE AND PROPERTY

- A. The CONTRACTOR shall plan and execute the Work to prevent damage to the underlying geosynthetic components of the landfill cap system. The CONTRACTOR shall protect existing structures, safeguard people and property, minimize traffic inconvenience, protect structures to be installed, and provide safe working conditions.
- B. Work shall be performed in accordance with all applicable health and safety and OSHA regulations, and in accordance with the CONTRACTOR's Site-specific Health and Safety Plan.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Soil material used as the vegetative layer shall be loam, clayey loam, silty loam, loamy sand, sandy loam, or sandy clay loam as defined by the U.S. Department of Agriculture textural classification chart, and shall be suitable to support vegetative growth.
- B. All imported fill materials shall be obtained from off-Site deposits of natural geologic materials. Recycled and/or reprocessed materials shall not be used on-Site. In addition, mixtures of recycled/reprocessed and natural materials shall not be use on-Site. Specifically, recycled/reprocessed materials shall include, but not be limited to, recycled concrete and bituminous concrete materials.
- C. The vegetative layer shall not contain stones, lumps, roots, or similar objects larger than two (2) inches in any dimension. Vegetative layer shall not contain shells.
- D. The vegetative layer shall have a pH between 5.8 and 7.6. In addition, a Synthetic Precipitation Leaching Procedure (SPLP) test shall be run on the fill materials prior to use on-site. The SPLP will be run using a solution with pH of 4.5. The pH of the resulting leachate will be tested to verify the pH is within the range of 4.5 to 8.5.
- E. Provide a material for the vegetative layer that has a minimum organic content of 2.75 percent by weight, and a maximum organic content of seven (7) percent by weight.
- F. Soil material used as the vegetative layer must be capable of sustaining vegetation as specified in Section 02936 of these Specifications.

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- G. Composted material from the clearing and grubbing operations of Section 02110 of these Specifications may be mixed and incorporated into the vegetative layer. The maximum size of composted fragments shall be two (2) inches.

2.02 TESTING

- A. The CONTRACTOR shall, at least twenty-one (21) calendar days prior to use of proposed materials, submit to the QUALITY ASSURANCE OFFICER (QAO) for favorable review, certification that the material proposed for the vegetative layer meets the requirements of Article 2.01 herein. This certification shall include the following tests for the material and the material source(s):
 - 1. Particle Size ASTM D422
 - 2. pH ASTM D4972
 - 3. Organic Content ASTM D2974
 - 4. Soil Fertility Baker or LaMotte Test
- B. The CONTRACTOR shall be responsible for initial pre-qualification testing. Testing shall be performed by a specialized laboratory that has been favorably reviewed by the REMEDIAL DESIGNER and/or QAO.
- C. The frequency of testing shall be once per every five-hundred (5,000) cubic yards of material delivered or once per each material source, whichever is greater.
- D. The CONTRACTOR shall submit to the QAO certification of compliance along with a minimum of fifty (50) pounds of each proposed material from each proposed source.
- E. The CONTRACTOR shall not proceed with the use of the material(s) until the USEPA, if necessary, and GROUP's REPRESENTATIVE have favorably reviewed the proposed materials.
- F. If, in the opinion of the REMEDIAL DESIGNER and/or QAO, the CONTRACTOR's proposed material is unsuitable for the proposed application, the CONTRACTOR shall submit the above certification for material of another type or from another source for consideration.
- G. The CONTRACTOR shall certify that the off-Site material is environmentally clean, in accordance with N.J.A.C. 7:26E, and shall provide analytical test results to support this certification. The GROUP may elect to perform additional analytical testing, at its own cost, of samples obtained from the CONTRACTOR's off-Site source to verify that the material is environmentally clean. The CONTRACTOR shall cooperate with the GROUP in obtaining samples for this purpose. The GROUP may reject any sources proposed by the CONTRACTOR based on analytical test results or past history of the source of the material.

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- H. Any imported materials from off-Site borrow sources found to not be in accordance with the Specifications, or found to be contaminated, shall immediately be removed and replaced with suitable materials at the CONTRACTOR's sole expense with no time extensions in the Construction Schedule granted. Costs associated with the QAO's effort to comply with the CQAP for this replacement effort shall be borne by the CONTRACTOR as well.

PART 3 - EXECUTION

3.01 PRECAUTIONS

- A. Vegetative support soil shall not be placed using frozen materials. Previously placed soil that has become frozen shall be removed and replaced, or otherwise recompacted after thawing has occurred, as approved by the QAO.
- B. Vegetative support soil shall not be placed over snow, ice, standing water, or on a previous lift which is excessively moist, dry, cracked, rutted, or loose.

3.02 STORAGE

- A. Stockpile satisfactory excavated and imported materials where directed by the GROUP's REPRESENTATIVE until required for placement. Place, grade and shape stockpiles to provide proper drainage. Seal stockpiles with a smooth drum roller to avoid excessive moisture retention. Install appropriate erosion and sediment control devices around stockpiles.
- B. Locate and retain stockpiled soil materials in a location where the weight of the stockpiled materials will not create surcharge loading conditions on the edges of excavation as specified in Section 02220.

3.03 PLACEMENT

- A. The vegetative support layer shall be placed in all designated areas as shown on the Contract Drawings, in areas disturbed by construction activities, and as directed by the QAO or GROUP's REPRESENTATIVE.
- B. No vegetative layer material shall be placed until the cover soil placement (or backfill, fill, etc.) is complete and approved by the QAO.
- C. The vegetative layer shall be placed in a single lift with a final, compacted thickness of six (6) inches.
- D. The CONTRACTOR shall take care to ensure that underlying soil remains intact and does not become mixed with the vegetative layer during installation.

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- E. Heavy equipment and trucks shall be prohibited from traveling on the vegetative support layer except on temporary roadways which are constructed to the minimum thickness as listed below based on the ground pressure of the equipment or vehicles:

Maximum Allowable Equipment Ground Pressure (pounds per square inch (psi))	Minimum Thickness of Overlying Material (inches)
<5	12
5-10	18
10-20	24
>20	36

3.04 FIELD QUALITY ASSURANCE/CONTROL

- A. The QAO shall obtain samples for laboratory testing and shall perform thickness measurements of the vegetative support as required by the CQA Plan. The CONTRACTOR shall cooperate with and assist the QAO with sampling and thickness measurements as required to meet the requirements of the CQA Plan. The CONTRACTOR shall remediate the vegetative support layer as indicated by testing or field measurements to the satisfaction of the QAO.
- B. The CONTRACTOR shall be responsible for conducting any and all quality control testing necessary for CONTRACTOR's purposes to satisfy the Contract Documents. The CONTRACTOR shall ensure that materials placed do not exceed maximum thicknesses as required by the Contract Documents.

3.05 SURVEY CONTROL AND TOLERANCES

- A. Survey the limits and elevation of the top of the vegetative support layer in accordance with Section 01050.
- B. Construct the vegetative support layer to -0.0 to +0.2 feet of the thickness shown on the Construction Drawings.
- C. Construct the vegetative support layer to maintain the minimum and maximum slopes as indicated on the Construction Drawings.

*****END OF SECTION*****

SECTION 02233

AGGREGATE MATERIALS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. CONTRACTOR shall furnish all labor, materials, equipment, tools, and appurtenances required to complete the Work of furnishing, placing, and compacting the aggregate materials for the access roads, and perimeter drainage trench crossing, as shown, specified or required by the Contract Documents or as specified by the REMEDIAL DESIGNER.
- B. CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations and laws of local, State, and Federal authorities having jurisdiction. CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect all Work.

1.02 RELATED SECTIONS

- A. Section 02223 – Backfill and Fill
- B. Section 02595 – Geotextiles
- C. Section 02599 – Geocomposite Drainage Layer

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Aggregate materials shall be stored in designated areas approved by the GROUP's REPRESENTATIVE. The CONTRACTOR shall be responsible for maintaining the aggregate materials to be free of deleterious material, and any aggregate materials determined by GROUP's REPRESENTATIVE or QAO to be deleterious material shall not be used for the required construction activities.
- B. All imported fill materials shall be obtained from off-Site deposits of natural geologic materials. Recycled and/or reprocessed materials shall not be used on-Site. In addition, mixtures of recycled/reprocessed and natural materials shall not be use on-Site. Specifically, recycled/reprocessed materials shall include, but not be limited to, recycled concrete and bituminous concrete materials.
- C. Coarse Aggregate Materials
 - 1. Coarse aggregate materials shall be washed crushed stone or gravel consisting of hard, strong, durable, non-carbonate particles conforming to

New Jersey Department of Transportation (NJDOT) Standard Specifications, and free from slag, cinders, ashes, rubbish, organics, or other deleterious material.

2. Coarse aggregate materials shall meet AASHTO No. 57 stone specifications and the following grading requirements:

<u>U.S. Standard Sieve Size</u>	<u>Percent Passing by Weight</u>
1-1/2 inch	100
1 inch	95-100
1/2 inch	25-60
No. 4	0-10
No. 8	0-5

3. Non-carbonate shall be defined as less than fifteen (15) percent loss by weight of the aggregate sample when the material is tested in accordance with ASTM D3042.

C. Dense Graded Aggregate Materials

1. Dense graded aggregates (DGA) shall consist of broken stone.
2. Dense graded aggregate materials shall conform to the following grading requirements:

<u>U.S. Standard Sieve Size</u>	<u>Percent Passing by Weight</u>
1 1/2 inch	100
3/4 inch	55-90
No. 4	25-60
No. 50	5-25
No. 200	3-12

3. The portion of dense graded aggregate passing the No. 50 sieve shall be non-plastic.
4. Dense Graded Aggregate shall not contain any slag.

D. AASHTO No. 1.

1. Coarse aggregate materials shall be washed crushed stone or gravel consisting of hard, strong, durable, non-carbonate particles conforming to New Jersey Department of Transportation (NJDOT) Standard

Specifications, and free from slag, cinders, ashes, rubbish, organics, or other deleterious material.

2. Coarse aggregate materials shall meet AASHTO No. 1 stone specifications and the following grading requirements:

<u>U.S. Standard Sieve Size</u>	<u>Percent Passing by Weight</u>
4 inch	100
3-1/2 inch	95-100
2-1/2 inch	25-60
1-1/2 inch	0-15

3. Non-carbonate shall be defined as less than fifteen (15) percent loss by weight of the aggregate sample when the material is tested in accordance with ASTM D3042.

2.02 TESTING

- A. CONTRACTOR shall, at least twenty-one (21) calendar days prior to use of proposed materials, submit to the QAO for favorable review, certification that the materials proposed for use as aggregate materials comply with the specification for the proposed application. The certification shall be project-specific, i.e., mention the project by name and shall be notarized. The certification shall include, but not necessarily be limited to, testing provided by the material supplier including the following tests:
 1. Grain Size ASTM D422
 2. Relative Density (DGA only) COE EM1110-2-1906 (App. 12A)
 3. Carbonate Content ASTM D3042
 4. Durability ASTM C1137 (DGA only)
ASTM C535 (all others)
- B. Additional confirmatory testing may be performed by the GROUP's REPRESENTATIVE and the QAO at the GROUP's expense and as required by the CQA Plan to confirm compliance with these specifications.
- C. The CONTRACTOR shall submit to the QAO certifications of compliance, as specified above, along with a minimum fifty (50) pound sample of each type of proposed material for each proposed borrow source.
- D. No material shall be placed unless approved by QAO.
- E. The CONTRACTOR shall certify that the off-Site materials are environmentally clean, in accordance with N.J.A.C. 7:26E, and shall provide analytical test results to support this certification. The GROUP may elect to perform additional

analytical testing, at its own cost, of samples obtained from the CONTRACTOR's off-Site source to verify that the material is environmentally clean. The CONTRACTOR shall cooperate with the GROUP in obtaining samples for this purpose. The GROUP may reject any sources proposed by the CONTRACTOR based on analytical test results or past history of the source of the material.

- F. If, in the opinion of the QAO, the aggregate material is unsuitable for the proposed application, the CONTRACTOR shall submit the QAO certifications of compliance, as specified above, for alternate materials from a different borrow source, at no additional cost to the GROUP.

PART 3 – EXECUTION

3.01 PLACEMENT

- A. Aggregate Materials shall be placed in uniform layers to the lines, thicknesses, and grades shown on the Contract Drawings.
- B. Backfilling with aggregate materials shall be performed by the CONTRACTOR in a manner such that the material is kept clean and free of deleterious materials.
- C. The GROUP's REPRESENTATIVE or QAO may at any time inspect the in-place aggregate materials or aggregate material stockpiles for deleterious material, and reject all or portions of the material, if necessary.

*****END OF SECTION*****

SECTION 02274

STONE RIPRAP

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall provide all labor, materials, equipment, tools, and appurtenances required to complete the work of furnishing and placing stone riprap, as shown, specified or required by the Contract Documents.
- B. CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations and laws of local, State, and Federal authorities having jurisdiction. CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect all Work.

1.02 RELATED SECTIONS

- A. 02223 – Backfill and Fill
- B. 02595 – Geotextiles
- C. 02599 – Geocomposite Drainage Layer

PART 2 – PRODUCTS

2.01 MATERIAL

- A. Stone riprap shall be hard, durable, subangular material. It shall be free from any considerable amount of flat, laminated or elongated particles; and shall be free from cracks, shells, clay, organic matter, or other deleterious matter.
- B. The stone riprap shall have a minimum Specific Gravity of 2.50, as defined by ASTM C127.
- C. The stone riprap shall be composed of an evenly distributed mixture of particle sizes. Fifty (50) percent of the mixture by weight shall be larger than the d_{50} size shown on the Contract Drawings. The largest stone size in this mixture shall be 2.0 times the d_{50} size. The diameter of the smallest stone size in this mixture shall be 0.5 times the d_{50} size.
- D. The breadth or thickness of each stone shall not be less than 1/3 its length.

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2.02 TESTING

- A. The CONTRACTOR shall, at least twenty-one (21) calendar days prior to use of proposed materials, submit to the QUALITY ASSURANCE OFFICER (QAO) for favorable review, certification that the material proposed for use as stone riprap meets the requirements of Article 2.01 herein. This certification shall include particle size testing in accordance with ASTM D5519 for the stone riprap material and for each material source.
- B. The CONTRACTOR shall be responsible for testing. Testing shall be performed by a materials testing laboratory in accordance with Section 01410.
- C. The CONTRACTOR shall submit to the QAO certification of compliance along with a minimum of fifty (50) pounds of each proposed material from each proposed source.
- D. The CONTRACTOR shall not proceed with the use of the material until the QAO has favorably reviewed the proposed materials.
- E. If, in the opinion of the QAO, the CONTRACTOR's proposed material is unsuitable for the proposed application, the CONTRACTOR shall submit the above certification for material of another type or from another source for consideration.
- F. The CONTRACTOR shall certify that the off-Site materials are environmentally clean, in accordance with N.J.A.C. 7:26E, and shall provide analytical test results to support this certification. The GROUP may elect to perform additional analytical testing, at its own cost, of samples obtained from the CONTRACTOR's off-site source to verify that the material is environmentally clean. The CONTRACTOR shall cooperate with the GROUP in obtaining samples for this purpose. The GROUP may reject any sources proposed by the CONTRACTOR based on analytical test results or past history of the source of the material.
- G. Any imported materials from off-Site sources not in accordance with the Specifications, or determined to be contaminated, shall immediately be removed and replaced with suitable materials at the CONTRACTOR's sole expense with no time extensions in the Construction Schedule granted.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. All vegetation shall be mechanically cleared from the ground surface, to minimize re-growth of vegetation through the stone riprap.

- B. Stone riprap shall be placed over geotextile to the minimum thicknesses shown on the Contract Drawings.
- C. The CONTRACTOR shall place stone riprap in a manner such that the material is graded to blend in with existing or proposed surrounding grades and to prevent surface water ponding or erosion.
- D. Stone riprap shall be placed in a manner that will not damage the underlying geotextile, utilities, or other facilities. Stone riprap shall not be dropped from a height exceeding three feet. Compaction of riprap over geotextile-lined slopes, channels, etc. is prohibited.
- E. The tolerance in stone riprap thickness in place shall be minus 0.0 feet to plus 0.25 feet.

*****END OF SECTION*****

SECTION 02402

LIQUIDS HANDLING AND DISPOSAL

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. This Section describes requirements and restrictions for handling and disposal of liquids generated during construction activities including, but not limited to, water resulting from decontamination, accumulation of precipitation, and/or groundwater encountered during construction, and excavation dewatering. The CONTRACTOR shall furnish all materials, equipment, transportation, and labor necessary to complete the Work.
- B. In general, water from “clean excavations”, as determined by the QUALITY ASSURANCE OFFICER (QAO), shall be discharged through sediment traps. Other liquids shall be managed separately as described herein.
- C. The CONTRACTOR will abide by all pertinent NJDEP, USEPA, OSHA, and other applicable regulations and guidelines, and the directions of the QAO and GROUP’s REPRESENTATIVE when performing all work applicable to this Section. The CONTRACTOR shall provide a “Competent Person” to implement, supervise and inspect the Work.

1.02 SUBMITTALS

- A. The CONTRACTOR shall submit a description of methods for containing, collecting, and disposing of liquids generated during construction, including, but not limited to, surface water runoff, groundwater, and decontamination water.
- B. Submit in accordance with Section 01300 of these Technical Specifications.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 ON-SITE HANDLING

- A. The handling of liquids shall be done in a manner such that the liquids will be contained on the Site, and not be allowed to flow onto the ground or off the Site, as surface water discharge. Discharge of collected groundwater or other liquids to adjacent surface waters or ground surfaces will not be allowed. Any damage or pollution to adjacent soil or surface waters due to the CONTRACTOR’s

actions or negligence under this requirement, or any fines, penalties, costs of clean-up or reconstruction required as a result thereof, shall be at the sole expense of the CONTRACTOR. The CONTRACTOR shall immediately remedy, clean-up, and correct any conditions as a result of its pollution of surface waters.

- B. The CONTRACTOR shall furnish secure, watertight temporary storage for the entire duration of liquids handling. The storage shall be accessible by tanker trucks. The handling of liquids shall be done in a manner such that the liquids remain at acceptable suspended solids levels for the approved disposal facility. Filter or settle as necessary to minimize suspended solids.
- C. Separate, segregate, and divert surface water runoff from groundwater encountered during excavation and Site grading activities. Handle groundwater separately from surface water runoff. The CONTRACTOR shall maintain all ground and surface water control measures as necessary, and as directed by the GROUP's REPRESENTATIVE.
- D. Any non-aqueous liquids encountered shall be immediately brought to the attention of the GROUP's REPRESENTATIVE. Non-aqueous liquids shall be collected separately in drums or other containers provided by the CONTRACTOR for temporary storage.

3.02 TRANSPORT AND DISPOSAL - AQUEOUS LIQUIDS

- A. The CONTRACTOR shall collect, pump, store, handle, and transfer surface water that is allowed to come in contact with waste materials, groundwater or other liquids intercepted, segregated, and collected during performance of the Work.
- B. The CONTRACTOR shall dispose of aqueous liquids at an off-Site permitted treatment facility approved by the GROUP's REPRESENTATIVE. The CONTRACTOR shall perform any characterization required for this off-Site disposal and as requested by the GROUP's REPRESENTATIVE.
- C. Settled solids and used filter materials shall be disposed of off-Site with the approval of the GROUP's REPRESENTATIVE.

3.03 MANAGEMENT OF NON-AQUEOUS LIQUIDS

- A. Any non-aqueous liquids found shall be removed by the CONTRACTOR and stored in separate drums prior to disposal. Coordinate with the GROUP's REPRESENTATIVE to schedule additional testing.
- B. Containerized non-aqueous or oily liquids, or solvents shall be stored at a designated area of the Site satisfactory to the GROUP's REPRESENTATIVE, and provided with secondary containment by the CONTRACTOR.

- C. The CONTRACTOR shall dispose of non-aqueous liquids at an off-site permitted treatment facility approved by the GROUP's REPRESENTATIVE. The CONTRACTOR shall perform any characterization required for this off-site disposal, and as requested by the GROUP's REPRESENTATIVE.

*****END OF SECTION*****

SECTION 02450

IN-SITU “HOT SPOT” TREATMENT

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. CONTRACTOR shall furnish all labor, equipment, materials, tools, and appurtenances, and perform all operations necessary to complete the required In-Situ “Hot Spot” Treatment activities, as indicated on the Contract Drawings and as specified herein.
- B. The Work of this Section includes, but is not limited to, in-situ soil treatment utilizing a combination of In-Situ Air Stripping (ISAS) and In-Situ Soil Stabilization (ISS) techniques/methods, grading of generated “swell” materials at ground surface, and other related and/or incidental work within the designated In-Situ “Hot Spot” Treatment area, as indicated on the Contract Documents.
- C. CONTRACTOR shall undertake the specified In-Situ “Hot Spot” Treatment activities (i.e., both ISAS and ISS) until post-treatment conditions within the designated treatment area are in compliance with the designated performance (i.e., acceptance) criteria, as specified herein.
- D. CONTRACTOR shall provide a “Competent Person” to implement, supervise, and inspect the Work.
- E. CONTRACTOR shall locate all existing active and abandoned utilities and structures in designated Work areas prior to commencing any air stripping and/or in-situ soil stabilization activities. The CONTRACTOR shall also protect from damage those utilities and structures, which are to remain in place, as necessary.
- F. CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations and laws of local, State, or Federal authorities having jurisdiction.

1.02 RELATED SECTIONS

- A. 00200 – Information available to Bidders
- B. 01050 – Field Engineering/Surveying
- C. 01550 – Site Access and Traffic Control
- D. 01562 – Dust Control
- E. 01563 – VOC, Odor, Vector and spill Control
- F. 01564 – Health and Safety
- G. 02100 – Site Preparation
- H. 02110 – Site Clearing and Grubbing
- I. 02125 – Erosion and Sediment Control

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- J. 02140 – Control of Water
- K. 02210 – Site Grading
- L. 02220 – Excavation
- M. 02221 – Soil and Waste Disposal
- N. 02223 – Backfill and Fill
- O. 02224 – Cover Soil
- P. 02402 – Liquids Handling and Disposal

1.03 REFERENCES

A. American Petroleum Institute (API):

- 1. API Spec 13A Drilling-Fluid Materials
- 2. API RP 13B-1 Field Testing Water Based Drilling Fluids

B. American Society For Testing and Materials (ASTM):

- 1. ASTM D422 Particle-Size Analysis of Soils
- 2. ASTM D1586 Standard Method for Penetration Test and Split-Barrel Sampling of Soils
- 3. ASTM D1632 Standard Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory
- 4. ASTM D1632 Standard Practice for Compressive Strength of Molded Soil-Cement Cylinders
- 5. ASTM D2216 Laboratory Determination of Water (Moisture)
- 6. ASTM D2434 Standard Test Method for Permeability of Granular Soils
- 7. ASTM D2487 Test Method for Classification of Soils for Engineering Purposes
- 8. ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- 9. ASTM D5084 Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter.

C. New Jersey Administrative Code (N.J.A.C.):

- 1. N.J.A.C. 7:27 Air Pollution Control
- 2. N.J.A.C. 7:26E Technical Requirements for Site Remediation

1.04 DEFINITIONS

- A. In-Situ Air Stripping (ISAS): The mixing of contaminated subsurface materials in-place (i.e., in-situ) utilizing shrouded single-blade and/or multiple auger systems. Ambient air, “hot” air (i.e., steam), and/or other oxidants shall be injected, as necessary, to enhance the release of Volatile Organic Compounds (VOCs). CONTRACTOR shall not be allowed to utilize un-shrouded ISAS systems. CONTRACTOR shall be responsible for the development, design and

implementation of all means-and-methods to collect, treat and discharge of all VOCs released during the course of the ISAS process. ISAS shall precede the specified ISS operations.

- B. In-Situ Soil Stabilization (ISS): The mixing of contaminated subsurface materials in-place (i.e., in-situ) utilizing single-blade and/or multiple auger systems in combination with the introduction of reagent materials (i.e., cement grout, lime, bentonite, and fly ash) into the mixing process to solidify and stabilize the subsurface materials in-place. ISS shall follow the specified ISAS operations, and times between ISAS and ISS operations shall be established by CONTRACTOR, provide the specified post-treatment performance (i.e., acceptance) criteria are achieved, as specified herein.
- C. Soil Mix Column: A subsurface column constructed in-situ by a soil-mixing machine using a mixing auger(s) capable of injecting ambient air, “hot” air (i.e., steam), oxidants, and slurry to the specified design depth, as indicated on the Contract Drawings. The mixing auger(s) penetrates and mixes the subsurface waste creating contiguous columns of stabilized materials.
- D. Slurry: A stable suspension of reagent materials (i.e., cement, lime, bentonite, and fly ash) within an aqueous matrix. Slurry mix designs shall be consistent with that presented in the Focus Feasibility Study (FFS) Report for Operable Unit No. 2 (OU-2), dated April 2001, or approved equivalent.
- E. Injection Ratio: A volumetric ratio of slurry to soils/sludge to be mixed into ISS treated columns. Injection ratios shall be consistent with those presented in the FFS Report for OU-2, dated April 2001, or approved equivalent.
- F. Stroke: A stroke is one complete pass, from ground surface to the designated target depths and back to the surface, of the augers through the designated treatment zone.
- G. Working Area: The working area is the surface within the designated In-Situ “Hot Spot” Treatment area from which the ISAS and ISS equipment operate.
- H. Field Verification Test Program: A set of five (5) overlapping ISAS/ISS columns use to demonstrate and document that the specified In-Situ “Hot Spot” Treatment activities will comply with the specified post-treatment performance (i.e., acceptance) criteria, as defined herein.

1.05 SUBMITTALS

- A. Prior to commencing ISAS/ISS operations on-Site, CONTRACTOR shall submit the following to the GROUP’s REPRESENTATIVE and REMEDIAL DESIGNER for review and approval:

1. In-Situ “Hot Spot” Treatment Work Plan: CONTRACTOR shall prepare and submit a detailed, comprehensive ISAS/ISS work plan, which includes, but not limited to, the following:
 - a. CONTRACTOR and/or SUBCONTRACTOR Qualifications;
 - b. Description of CONTRACTOR’s construction methodology, means-and-methods, and sequences of construction;
 - c. Field verification program procedures and sequences;
 - d. Shop drawings showing the limits, locations and depths of each individual ISAS/ISS soil column;
 - e. Detailed schedule of ISAS/ISS operations;
 - f. Material storage and lay-down areas;
 - g. ISS design mix, which shall be consistent with that presented in the FFS Report for OU-2, dated April 2001, or approved equivalent;
 - h. Description of slurry preparation and injection procedures;
 - i. Detailed descriptions of ISAS and ISS equipment;
 - j. Proposed methods to collect, treat and discharge released VOCs, which will be generated during the ISAS and ISS operations;
 - k. Manufacturer and/or supplier product data sheets;
 - l. Material certificates; and
 - m. Resumes of proposed ISAS/ISS field superintendents, foremen, specialists, and operators.
2. ISS Mix Design Report: CONTRACTOR shall be responsible for the development of a proposed ISS mix design, which shall be consistent with that presented in the FFS Report for OU-2, dated April 2001, or approved equivalent, to comply with the specified performance criteria, as defined herein. This report shall provide the proportions of reagent materials (i.e., cement, lime, bentonite, and fly ash) required to stabilize the target subsurface materials.
3. ISAS/ISS Quality Assurance/Quality Control (QA/QC) Plan: CONTRACTOR shall prepare and submit a ISAS/ISS QA/QC Plan. This plan shall include, but not be limited to, descriptions of CONTRACTOR’s quality control procedures, personnel, equipment, and testing procedures, sampling equipment and procedures, column depth measurement methods, wall verticality measurement methods, qualifications of proposed testing laboratories, and sample test forms for reporting results. This plan shall specifically address, at a minimum, how the testing requirements, as specified herein, shall be achieved and documented. Additional testing by CONTRACTOR shall also be described in this plan.
4. ISAS/ISS Remedy Plan: CONTRACTOR shall provide an explanation of the process to be employed if quality control samples do not meet the specified post-treatment performance criteria, as defined herein.

5. Permits (equivalencies): The CONTRACTOR file, obtain and provide copies of all federal, state and local permits (equivalencies) and/or certificates required to undertake and complete the specified In-Situ “Hot Spot” Treatment operations, including, but not limited to, all air pollution control permits/certificates, per N.J.A.C. 7-27.
- B. Upon completion of ISAS/ISS operations on-Site, CONTRACTOR shall submit the following to the GROUP’s REPRESENTATIVE and REMEDIAL DESIGNER for review and approval:
 1. As-Built Drawings: Scaled drawing showing the limits, locations and depths of all completed ISAS/ISS soil-mixed columns including, but not limited to, the layout, column numbering, sampling locations, and completed elevations and depths. These drawings shall be prepared based on field survey, in accordance with Section 01050 of these Technical Specifications.
 2. Material Certificates: Copies of all material certificates, as appropriate, from the Manufacturer for each lot shipped to the Site.
 3. Subsurface Exploration and Quality Control Sampling Logs: Logs of the subsurface explorations used to verify key-in depth of the soil-mixed columns, including surveyed location, completion depths, sampling intervals, and encountered material classifications.
 4. ISAS/ISS Quality Control Data: Copies of all ISAS and ISS quality control testing results, including validated analytical laboratory data.
- C. Submit in accordance with Section 01300 of these Technical Specifications.

1.06 QUALIFICATIONS

- A. ISAS/ISS CONTRACTOR: The ISAS/ISS CONTRACTOR shall have a minimum of five (5) years prior experience in both ISAS and ISS construction projects. The qualifications and experience of personnel who shall be responsible for conducting the ISAS/ISS operations shall include at least three (3) Client/Owner references (name and telephone number) for projects the CONTRACTOR worked previously on.
- B. ISAS/ISS Specialist: The ISAS/ISS Specialist shall be an individual with a minimum of three (3) years experience, including a minimum of five (5) relevant projects, with projects of similar nature, scope and complexity. The ISAS/ISS Specialist shall be adequately qualified to manage and supervise the specified operations, and shall be thoroughly knowledgeable with respect to the proposed ISAS/ISS construction equipment, installation procedures, and quality control testing requirements.

- C. ISAS/ISS Equipment Operator: ISAS/ISS Equipment Operators shall have a minimum of three (3) years experience using similar ISAS/ISS construction equipment, and these operators shall have successfully completed at least three (3) ISAS/ISS construction projects.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Materials delivered and placed in storage shall be protected from the weather, dirt, dust, contaminants, and stored in accordance with the Manufacturer’s recommendations.

1.08 SITE CONDITIONS

- A. Subsurface information is available on the Contract Drawings, which indicate the limits and depths of the designated In-Situ “Hot Spot” Treatment.
- B. Existing subsurface conditions have been investigated by the GROUP. Hence, the CONTRACTOR is encouraged to review all the available subsurface information within the vicinity of the designated In-Situ “Hot Spot” Treatment area. See Section 00200 of these Technical Specifications for additional information for the Site.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. ISS Slurry Materials (SM): CONTRACTOR shall be responsible for the timely delivery of the approved SM materials, and is responsible for ensuring that the product is delivered in a workable, uniform manner to achieve the project requirements. Impacts of the SM on the project shall be at the expense of the CONTRACTOR.
- B. Water: For the specified ISAS/ISS Operations, CONTRACTOR shall assume adequate sources of potable water do not exist on-Site. Hence, the CONTRACTOR shall be responsible for securing adequate source(s) of potable water required by the ISAS/ISS operations, and CONTRACTOR shall provide appropriate documentation showing that all imported water is potable.
- C. Additives: Additives/dispersants are permissible only upon the REMEDIAL DESIGNER’s review of independent demonstration submitted by CONTRACTOR, which demonstrates that the specified performance criteria, as defined herein, can be achieved and maintained.

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2.02 EQUIPMENT

- A. CONTRACTOR shall furnish all necessary ISAS and ISS plant and equipment for use on this project.
- B. ISAS/ISS Equipment: The ISAS/ISS columns shall be constructed utilizing CONTRACTOR's proposed equipment. The mixing shafts and blades shall be configured to be capable of blending the soil and slurry into a homogeneous mixture. The shafts will have a bottom discharge capability for the introduction of air, steam, and slurry materials. The power source for driving the mixing shafts shall be sufficient to provide thorough mixing capability to meet project requirements to the required depths. The equipment shall be able to reach at least ten (10) feet deeper than the maximum depth shown on the Contract Drawings. Rigid templates or other suitable devices shall be used to guide the positioning of each stroke and ensure a proper overlap and continuity of the installed ISAS/ISS columns.
- C. Mixing and Placing Slurry Equipment: The slurry mixing plant shall be capable of mixing the design slurry material to the extent necessary to achieve the specified performance criteria, as defined herein. Mixers shall be capable of achieving complete dispersion of SM, and shall be capable of continually mixing the slurry to provide uniform, blended slurry without either visible settling of SM or a formation of a SM-deficient supernatant layer. The slurry shall be mechanically or hydraulically agitated in the slurry storage facility to maintain uniform properties throughout.
- D. Field Laboratory Equipment: The field laboratory shall contain the minimum equipment to perform the necessary on-Site laboratory work.
- E. In-Situ Sampling Tool: CONTRACTOR shall utilize sampling tools capable of obtaining samples of disturbed, wet mixed soils at various depths within the ISAS/ISS columns. These samplers shall be capable of being opened and closed from the surface to obtain representative sample for inspection and quality control testing. The sampler may be attached to the ISAS/ISS equipment or supported by other equipment, as appropriate.

2.03 ISS DESIGN MIXES

- A. Additives: The use of additives shall be subject to the requirements stated herein.
- B. ISAS/ISS Column Material: The ISAS/ISS column materials shall have slurry-to-soil ratios sufficient to satisfying the specified performance criteria, as defined herein. Actual slurry-to-soil ratio may be dependant on workability considerations for the ISAS/ISS equipment; however, this shall not compromise the project specified performance criteria and may necessitate adjustments to the ISS design mixtures.

- C. CONTRACTOR’s proposed ISS design mix shall be consistent with that presented in the FFS Report for OU-2, dated April 2001, or approved equivalent.

PART 3 – EXECUTION

3.01 WORK AREA

- A. The Work Area is defined as the ground surface within the designated In-Situ “Hot Spot” Treatment area, as identified in the Contract Drawings. In preparation of the specified ISAS/ISS operations, the entire Work Area will be cleared and grubbed and prepared in accordance with Sections 02100 and 02110 of these Technical Specifications.
- B. ISAS/ISS column construction shall be accomplished from the ground surface. CONTRACTOR may place ground reinforcement materials (i.e. reinforcement mesh, grids, panels or platforms) on the ground surface to establish stable working platforms for the execution of ISAS/ISS activities. Removal of stuck equipment will be done at the CONTRACTOR’s expense. The REMEDIAL DESIGNER may request the CONTRACTOR to place ground surface reinforcement materials at any time.
- C. CONTRACTOR’s operations extending beyond the designated limits of In-Situ “Hot Spot” Treatment, as shown on the Contract Drawings, shall require approval by the GROUP’s REPRESENTATIVE and REMEDIAL DESIGNER for payment. If the CONTRACTOR proceeds with ISAS/ISS beyond the designated limits of treatment shown on the Contract Drawings without prior approval from the GROUP’s REPRESENTATIVE, CONTRACTOR shall be proceeding at its own risk, and costs associate with said “at-risk” construction activities will not be reimbursed by the GROUP.

3.02 ESTABLISHMENT/VERIFICATION OF WORK AREA SURFACE ELEVATIONS

- A. CONTRACTOR shall perform a detailed ground surface survey within the limits of the designated In-Situ “Hot Spot” Treatment area, prior to beginning ISAS/ISS operations. This survey will be conducted in accordance with Specification 01050 to establish the treatment limits shown on the Contract Drawings, to verify pre-treatment surface elevations, and to establish key locations required for the ISAS/ISS implementation. This survey information shall be further used to established quantities for payment, in accordance with Section 01025 of these Technical Specifications.

3.03 FIELD VERIFICATION PROGRAM

- A. Prior to commencing production ISAS/ISS operations on-Site, CONTRACTOR shall undertake and successfully complete a field verification testing program to

demonstrate its proposed construction methods and ISS mix designs are capable of achieving the specified performance criteria, as defined herein.

- B. The specified ISAS/ISS field verification program shall, at a minimum, establish the following:
 - 1. Rates of ISAS and ISS advancement/penetration;
 - 2. ISAS hold (i.e., mixing times); and
 - 3. Quality control testing requirements.
- C. CONTRACTOR shall utilize the same equipment, sequences of construction, procedures, and materials that will be used during production ISAS/ISS operations. If during production ISAS/ISS operations CONTRACTOR modifies its approved methods of construction, it may be require to undertake additional field verification testing programs, as determined and directed by the REMEDIAL DESIGNER.
- D. CONTRACTOR shall notify the GROUP's REPRESENTATIVE and the QUALITY ASSURANCE OFFICER (QAO) at least forty-eight (48) before starting the field verification program. Upon completion of the field verification program, CONTRACTOR shall prepare a field verification testing program summary report, which shall be submitted to the GROUP's REPRESENTATIVE and REMEDIAL DESIGNER for review and approval.
- E. The field verification program shall consist of at least five (5) overlapping ISAS/ISS columns, and this field verification program shall be divided into separate, independent ISAS and ISS operations (i.e., CONTRACTOR shall not be allowed to perform consecutive operations during this field verification program), which would allow for the ISAS and ISS to be evaluated independently and in combination to ensure the specified performance criteria can be achieved, as defined herein.
- F. As part of its ISAS/ISS Work Plan, CONTRACTOR shall indicate how it intends to monitor its ISAS and ISS operations during construction. In addition, this ISAS/ISS Work Plan shall include provisions for the collection and testing of requisite quality control samples.
- G. CONTRACTOR shall undertake its field verification program within an area selected by CONTRACTOR and agreed upon by the GROUP's REPRESENTATIVE and REMEDIAL DESIGNER. If quality control test results, as specified in Sub-Section 3.09 herein, indicates that the field verification program did not meet or exceed the project specified performance criteria, as defined herein, additional field verification testing shall be undertaken utilizing alternate, modified ISAS/ISS construction procedures, as recommended by CONTRACTOR and approved by the GROUP's REPRESENTATIVE and REMEDIAL DESIGNER.

- H. Any field verification test sections or subsequent ISAS/ISS columns not meeting the specified performance criteria, as defined herein, shall be abandoned or re-worked, as necessary, at CONTRACTOR's own cost. If the results generated during field verification program indicate that the quality control sampling frequencies and methods are inadequate, they shall be increased, and costs associated with this additional quality control testing shall be handled on a change order basis.
- I. Installation of production ISAS/ISS columns shall utilize the same methods, procedures, and ISS mix designs used during the field verification program. The test columns installed for the field verification program shall be incorporated into the overall In-Situ “Hot Spot” Treatment zone.

3.04 ESTABLISHMENT OF COLUMN DEPTHS/ELEVATIONS

- A. For each ISAS/ISS columns, depths and elevations of ISAS/ISS columns shall be established based on observed/measured lengths of auger advancement.

3.05 ISAS/ISS CONSTRUCTION

- A. The ISAS/ISS construction shall create a series of overlapping soil-mixed (i.e., treated and stabilized) columns. During the ISAS operations, the mixing columns shall be advance, and ambient air, “hot” air (i.e., steam), and/or oxidants shall be injected into the mixing columns to enhance the release of VOC from the soil. During ISS operations, the mixing columns shall be advanced, and reagent (i.e., cement, lime, bentonite, and fly ash) materials shall be introduced, per CONTRACTOR's approved mix design proportions, into the mixing column to stabilize, solidify the subsurface materials in-place. The mixing columns shall be located, positioned such that they create overlapping columns.
- B. Rates of ISAS column penetration/construction shall be monitored and recorded for each stroke, and requisite ISAS mixing hold times shall be established during the specified ISAS/ISS field verification program. The CONTRACTOR shall continuously monitor and record, at a minimum, Total VOC levels within the shroud around the augering system. ISAS shall continue until such time that the Total VOC inside the shroud are consistent with those observed during the successful ISAS/ISS field verification program.
- C. Rates of ISS column advancement/extraction shall be monitored and recorded for each stroke, and these rates may be adjusted in the field to accommodate variable penetration resistances, based on the degree of drilling difficulty. Additional mixing or strokes may be required to evenly distribute the SM throughout the column. The rotation speed shall be maintained at a maximum during withdraw to maximize mixing. The bottom of each stroke shall be double-mixed by raising the mixing shafts ten (10) feet off the bottom and then reinserting them to the bottom while mixing.

- D. Total depths of penetration shall be measured for each stroke. The total penetration depth shall meet or exceed those depths shown on the Contract Drawings. Penetration below the depths shown on the Contract Drawings shall be at the CONTRACTOR own expense.
- E. The SM injection rate shall be monitored and recorded for each stroke and adjusted as necessary to facilitate construction and meet project the specified performance criteria, as defined herein.
- F. Pumps shall be used to transfer the ISS slurry to the augers. CONTRACTOR shall ensure that the slurry is injected in each shaft by using separate pumps, multiple meters, tell-tales, valving, or other methods approved by the REMEDIAL DESIGNER. The flow of slurry through each shaft shall be verified prior to each stroke by observing the flow out of each shaft when the shafts are suspended in the air above the mixing wall. Any blockage in any of the shafts shall be cleared prior to injection and mixing.
- G. ISAS/ISS operations shall not proceed when inclement weather conditions are anticipated to impact the quality of work performed.
- H. Each ISAS/ISS columns and panels shall be recorded by number and date installed and depth penetrated.
- I. The ISAS/ISS columns shall be sampled as required in Article 3.09.

3.06 STABILITY

- A. The stability of the ISAS/ISS columns shall be maintained. Surcharges from equipment loads, soil stockpile loads, and any other situations shall not adversely influence column stability. In the event of ISAS/ISS column failures, CONTRACTOR shall re-mix the associated ISAS/ISS columns, and undertake corrective actions to prevent subsequent ISAS/ISS column collapses, at no additional expense to the GROUP.

3.07 HANDLING OF EXCESS MATERIALS

- A. Excess materials (i.e., swell) that may overflow from the ISAS/ISS columns by bulking during mixing shall be handled by CONTRACTOR in a manner that directs these materials back toward the areas that are being contained by the ISAS/ISS columns. This shall involve draining the overflow to the interior columns or area to be contained.
- B. CONTRACTOR may be required to construct temporary trenches and/or perimeter berms along the perimeter of ISAS/ISS treatment to control the overflow and spread of excess (i.e., swell) materials, and to facilitate construction.

- C. Excess ISAS/ISS materials (i.e., swell) shall be utilized as grading fill with areas designated by the REMEDIAL DESIGNER. Under this Contract, CONTRACTOR shall not be responsible for the off-Site disposal of excess ISAS/ISS materials. If CONTRACTOR is required to dispose of said materials off-Site, costs associated with this off-Site disposal shall be processed on a change order basis.

3.08 CONSTRUCTION TOLERANCES

- A. ISAS/ISS columns shall be constructed to be plumb within two (2) percent of vertical, as measured in a manner subject to the REMEDIAL DESIGNER's approval.
- B. Depth of ISAS/ISS columns shall be measured from the adjacent ground surface elevation to the auger completion depth, and measured based on direct observation of the augering systems “Kelley” bars. The method of measurement shall be in a manner subject to the REMEDIAL DESIGNER's approval.
- C. ISAS/ISS columns shall not deviate more than six (6) inches from the locations shown in CONTRACTOR's approved shop drawings, which are part of the specified ISAS/ISS Work Plan.
- D. Variance from the above tolerances shall not be permitted without approval from the GROUP's REPRESENTATIVE and REMEDIAL DESIGNER.

3.09 CONSTRUCTION QUALITY CONTROL

- A. CONTRACTOR shall be responsible for construction quality control (QC) to verify that the ISAS/ISS columns are constructed in accordance with the project requirements. The quality control activities shall involve observations, measurements, and testing as prescribed below. Variation from the required tests, frequencies, and criteria are subject to prior approval of the REMEDIAL DESIGNER.
- B. ISAS/ISS Column Continuity and Depths: CONTRACTOR shall perform and document the following Quality Control requirements:

ISAS/ISS Column Continuity and Depth Control			
Item/Test	Reference Test Standard	Frequency (min.)	Criteria
Column Verticality	None	1 per column	Within two (2) percent of vertical.
Column Depths/Elevations	None	1 per column	Within two (2) inches of depths shown in the Contract Drawings.
Column Alignment (horizontal)	Survey	1 per column	Within six (6) inches of the CONTRACTOR's approved ISAS/ISS Shop Drawing locations.

- C. ISS Slurry Material: CONTRACTOR shall perform and document the following Quality Control requirements.

ISS Slurry Material Control			
Item/Test	Reference Test Standard	Frequency	Criteria
Injection Ratio	None	1 per stroke	Ratio varies based on tailings conditions and workability.
Penetration Ratio	Visual	1 per stroke	As required.
Slurry Material Proportion	None	1 per stroke	Percentage of slurry material.
Slurry Material Uniformity	Visual	1 per stroke	Visual appearance of mixture homogeneity.

- D. ISAS/ISS Mixed Columns: CONTRACTOR, using approved sampling devices, shall sample mixed ISAS/ISS columns, and sampling shall occur prior to solidification of the ISS slurry materials. Sampling locations shall be randomly distributed, selected by the REMEDIAL DESIGNER, and shall not be divulged to the ISAS/ISS CONTRACTOR until such time the quality control samples are collected. CONTRACTOR shall maintain all ISAS/ISS quality control samples in a designated, approved on-Site archive area. After the quality control samples, has sufficiently cured, they shall be tested, in accordance with these Technical Specifications, on-Site or at off-Site laboratories. If any quality control samples are transported to designated, approved off-Site testing laboratories, said samples shall be transported under appropriate “chains-of-custody”.

- E. CONTRACTOR shall perform Quality Control testing to confirm the quality of its Work, as prescribed herein. CONTRACTOR shall perform and document the following Quality Control requirements, as part of the requisite field verification program:

ISAS/ISS Mixed Columns Control – Field Verification Program			
Item/Test	Reference Standard	Frequency	Criteria
Ambient Air Quality	Per HASP	Per HASP	Per HASP
ISAS Activities	NJDEP Field Sampling Procedures Manual (2005)	Continuous	CONTRACTOR shall monitor VOC levels within the auger shroud.
Post-ISAS Head-Space Testing	NJDEP Field Sampling Procedures Manual (2005)	Two (2) auger-cutting garb samples per test column for a total of ten (10) samples.	None (Field Screening Tool).
Post-ISS Head-Space	NJDEP Field Sampling	Two (2) ISS grab samples per test	None (Field Screening Tool).

ISAS/ISS Mixed Columns Control – Field Verification Program			
Item/Test	Reference Standard	Frequency	Criteria
Testing	Procedures Manual (2005)	column for a total of ten (10) samples.	
Mixing Efficiency	Visual	Each sample taken.	Visual homogeneity evaluation.
Post-ISS Total VOC Testing	TCL VOCs	Two (2) samples per column collected at different depths for a total of ten (2) samples.	Average VOC levels of treated mass shall be equal to or less than 1,280 ppm.
Post-ISS Leachability Testing	SPLP on Intact Samples	Two (2) samples per column collected at different depths for a total of ten (2) samples.	Average leachability of treated mass shall be reduced by 90%, as compared to FFS results.
Post-ISS Strength Testing	ASTM D1633	Two (2) samples per column collected at different depths for a total of ten (2) samples.	Average 28-day strength of treated mass shall be fifteen (15) psi (min.).
Notes: 1) Post-ISS quality control samples shall be collected utilizing approved sampling apparatus, and sampling equipment shall be capable of collecting samples at discrete, varying depths. 2) Representative post-ISS samples shall be collected while the treated mass is “wet”, poured into molds for testing, and allowed to cure on-Site under representative conditions. 3) Post-ISS samples shall be stored on-Site in an environment where temperatures are maintained between 65°F to 85°F, and these samples shall not be moved or transported from the Site until a period of five (5) days has passed. 4) The CONTRACTOR shall collect and test additional QA/QC and field duplicate samples, as necessary.			

- F. CONTRACTOR shall perform Quality Control testing to confirm the quality of its Work, as prescribed herein. CONTRACTOR shall perform and document the following Quality Control requirements, as part of its production ISAS/ISS operations:

ISAS/ISS Mixed Columns Control – Production ISAS/ISS Operations			
Item/Test	Reference Standard	Frequency	Criteria
Ambient Air Quality	Per HASP	Per HASP	Per HASP
ISAS Activities	NJDEP Field Sampling Procedures Manual (2005)	Continuous	CONTRACTOR shall monitor VOC levels within the auger shroud.
Post-ISAS Head-Space Testing	NJDEP Field Sampling Procedures Manual (2005)	One (1) auger-cutting grab samples per every ten (10) columns.	None (Field Screening Tool).
Post-ISS Head-Space	NJDEP Field Sampling	One (1) ISS grab samples per every ten	None (Field Screening Tool).

ISAS/ISS Mixed Columns Control – Production ISAS/ISS Operations			
Item/Test	Reference Standard	Frequency	Criteria
Testing	Procedures Manual (2005)	(10) columns.	
Mixing Efficiency	Visual	Each sample taken.	Visual homogeneity evaluation.
Post-ISS Total VOC Testing	TCL VOCs	Two (2) samples, collected at different depths, per every ten (10) columns. CONTRACTOR shall test one (1) sample per every ten (10) columns, and remaining samples shall be archived.	Average VOC levels of treated mass shall be equal to or less than 1,280 ppm.
Post-ISS Leachability Testing	SPLP on Intact Samples	Two (2) samples, collected at different depths, per every ten (10) columns. CONTRACTOR shall test one (1) sample per every ten (10) columns, and remaining samples shall be archived.	Average leachability of treated mass shall be reduced by 90%, as compared to the FFS results.
Post-ISS Strength Testing	ASTM D1633	Two (2) samples, collected at different depths, per every ten (10) columns. CONTRACTOR shall test one (1) sample per every ten (10) columns, and remaining samples shall be archived.	Average 28-day strength of treated mass shall be fifteen (15) psi (min.).
Notes: 1) Post-ISS quality control samples shall be collected utilizing approved sampling apparatus, and sampling equipment shall be capable of collecting samples at discrete, varying depths. 2) Representative post-ISS samples shall be collected while the treated mass is “wet”, poured into molds for testing, and allowed to cure on-Site under representative conditions. 3) Post-ISS samples shall be stored on-Site in an environment where temperatures are maintained between 65°F to 85°F, and these samples shall not be moved or transported from the Site until a period of five (5) days has passed. 4) The CONTRACTOR shall collect and test additional QA/QC and field duplicate samples, as necessary.			

- G. CONTRACTOR shall also perform at the CONTRACTOR’s expense any additional testing beyond that identified by this specification to ensure the quality of work performed, such as slurry viscosity, field duplicates, QA/QC testing, etc.

- H. The REMEDIAL DESIGNER reserves the right to perform independent Quality Assurance (QA) tests on the project work. CONTRACTOR shall accommodate sampling and testing done by the QAO and/or REMEDIAL DESIGNER.
- I. Failing QC Tests Results: When and where CONTRACTOR’s Quality Control (QC) testing fails to comply with the specified performance criteria, as defined herein, CONTRACTOR shall delineate impacted ISAS/ISS treatment areas, which do not comply with the specified performance criteria. CONTRACTOR shall then remedy these areas by re-mixing the associated columns or implementing alternate corrective actions, as approved by the REMEDIAL DESIGNER. All costs associated with re-mixing any ISAS/ISS column or undertaking any corrective actions shall be at CONTRACTOR’s own expense, and shall not be reimbursed by the GROUP. After the associated columns have been re-mixed and/or corrective actions completed, CONTRACTOR shall perform additional QC testing at its own expense to verify that the specified performance criteria has been achieved in the field.
- J. All Quality Control sampling locations, as specified herein, shall be presented on the required “As-Built” drawings, and submit by CONTRACTOR to the GROUP’s REPRESENTATIVE.
- K. All additional samples taken by CONTRACTOR in excess of that required by this Technical Specification shall be at CONTRACTOR’s own expense, and not reimbursed by the GROUP. Locations of Quality Control samples shall be disclosed to the REMEDIAL DESIGNER, prior to sampling.
- L. All samples taken shall be appropriately labeled with permanent marker including date and time taken, column number, depth sampled, and a unique sample identification number.
- M. If justified and/or approved by the REMEDIAL DESIGNER, Quality Control requirements, as defined herein, may be relaxed (i.e., decreased) or increased, based on specific Site conditions encountered in the field. If the frequency and/or extent of Quality Control testing changes from that described herein, CONTRACTOR shall be informed.

3.010 SITE CLEANUP

- A. After completion of ISAS/ISS operations, the Site shall be cleared of construction debris and excess construction materials to the satisfaction of the GROUP’s REPRESENTATIVE and REMEDIAL DESIGNER, as necessary.
- B. Debris collected over the course of ISAS/ISS operations shall be disposed of in a manner approved by the GROUP’s REPRESENTATIVE.

3.011 AS-BUILT DRAWINGS

- A. CONTRACTOR shall submit “As-Built” drawings of the completed ISAS/ISS treatment area to the GROUP’s REPRESENTATIVE within fifteen (15) business days following completing of ISAS/ISS operations on-Site.
- B. All results of field data, field logs, Quality Control test results, and survey data shall be submitted to the REMEDIAL DESIGNER.

*** END OF SECTION ***

SECTION 02460

STEEL SHEET PILING

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. CONTRACTOR shall furnish all labor, equipment, materials, tools, and appurtenances, and perform all operations necessary for installing steel sheet piles, as indicated on the Contract Drawings and as specified herein.
- B. CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations, and laws of local, municipal, State, or Federal authorities having jurisdiction. The CONTRACTOR is responsible for identifying and obtaining all appropriate licenses, approvals, and permits to complete the work of this Section. The CONTRACTOR shall provide a “Competent Person” to implement, supervise, and inspect the Work.
- C. CONTRACTOR shall locate all existing active and abandoned utilities and structures in designated Work areas prior to commencing any steel sheet pile installations. The CONTRACTOR shall also protect from damage those utilities and structures which are to remain in place.

1.02 RELATED SECTIONS

- A. 01050 – Field Engineering/Surveying
- B. 01564 – Health and Safety
- C. 02100 – Site Preparation
- D. 02220 – Excavation
- E. 02223 – Backfill and Fill
- F. 02831 – Chain Link Fence and Gates

1.03 REFERENCES

The latest editions of the publications listed below form part of these Technical Specifications:

- A. American Welding Society (AWS):
 - 1. AWS D1.1/D1.1M – Structural Welding Code (Steel).
- B. ASTM International (ASTM):
 - 1. ASTM A328/A328M – Steel Sheet Piling.

2. ASTM A572/A572M – High-Strength, Low-Alloy Columbium-Vanadium Structural Steel.
3. ASTM A6/A6M – General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
4. ASTM A690/A690M – High-Strength, Low-Alloy Steel H-Piles and Sheet Piling for Use in Marine Environments.
5. ASTM A857/A857M – Steel Sheet Piling, Cold-Formed, Light Gage
6. ASTM A36/A36M – Carbon Structural Steel.

1.04 SUBMITTALS

- A. Work Plan: Prior to commencement of steel sheet piling installation activities on-Site, the CONTRACTOR shall prepare and submit, to the GROUP's REPRESENTATIVE, a detailed, comprehensive steel sheet pile installation work plan, which includes, but not limited to, the following:
 1. CONTRACTOR and/or SUBCONTRACTOR Qualifications;
 2. Methods and sequences of construction;
 3. Material storage and lay-down areas;
 4. Complete descriptions of sheet piling driving equipment, including hammers, extractors, protection caps, and other installation appurtenances;
 5. Proposed methods of extracting, pulling and/or re-driving of installed steel sheet piling;
 6. Manufacturer and/or supplier product data sheets; and
 7. Material certificates.
- B. Shop Drawings: Prior to commencement of steel sheet piling installation activities on-Site, the CONTRACTOR shall prepare and submit, to the GROUP's REPRESENTATIVE, detailed drawings for the specified steel sheet piling, including fabricating sections. These drawings shall show complete piling dimensions and details, driving sequences, and locations of installed piling. These drawings shall include details of top protection, special reinforcing tips, tip protection, lagging, splices, fabricated additions to plain piles, cut-off methods, and dimensions of templates and other temporary guide structures for installing piling. Drawings shall provide details of the methods of handling piling to prevent permanent deflection, distortion, or damage to piling interlocks.
- C. Records: CONTRACTOR shall prepare, maintain and submit, the GROUP's REPRESENTATIVE, complete records of the completed sheet piling driving operations. These records shall provide a system of identification that shows the disposition of approved piling in the work, driving equipment performance data, piling penetration rate data, piling dimensions, and top and bottom elevations of installed piling.

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- D. Manufacturer's Mill Certificates: For each shipment of material, CONTRACTOR shall submit, to the GROUP's REPRESENTATIVE, copies of all Manufacturer certified material test reports, showing that the sheet piling and appurtenant metal materials meet the specified requirements. These mill certificates shall be submitted for each shipment of material, and corresponding lot numbers for each shipment shall be clearly noted on said certificates. Material test reports shall meet the requirements of ASTM A6/A6M. Identification data shall include, but not be limited to, piling types, dimensions, chemical compositions, mechanical properties, section properties, heat numbers, and mill identification marks.
- E. Submit in accordance with Section 01300 of these Technical Specifications.

1.05 DELIVERY, HANDLING AND STORAGE

- A. Materials delivered to the Site shall be new and undamaged, and shall be accompanied by the Manufacturer's mill certification reports.
- B. Sheet piling shall be stored and handled in the manner recommended by the Manufacturer to prevent permanent deflection, distortion, or damage to the interlocks. At a minimum, the CONTRACTOR shall support all sheet piling on level blocks or racks spaced not more than ten (10) feet apart, and not more than two (2) feet from the ends.
- C. Concentrated loads that occur during stacking or lifting shall be limited to less than those that could produce permanent deformation of the material.
- D. Sheet pile handling devices shall be designed such that damage to protective coatings applied to the steel sheets is prevented.
- E. Storage of steel sheet piling shall be in such a manner to facilitate required inspection activities.

1.06 EQUIPMENT

- A. CONTRACTOR shall submit complete descriptions of the driving equipment, including caps, leads, and guides where required. The description of the hammer proposed for driving piles shall include make and model number.
- B. CONTRACTOR shall select the pile driving method and equipment such that existing buildings and structures, as specified in Sub-Section 1.08 herein, are protected against damage due to vibration and settlement that may be caused by the pile driving operation.

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- C. CONTRACTOR shall make such substitutions and modifications, found to be necessary during the progress of the work, as approved by the REMEDIAL DESIGNER.

1.07 DESIGNING AND DETAILING

- A. The locations, arrangements, lengths, and cross sections of steel sheets shall be as shown/indicated on the Contract Drawings.
- B. CONTRACTOR shall design and detail all corners, wyees, and other special shapes, connections, and appurtenant items necessary to make the sheet pile retaining wall complete.
- C. CONTRACTOR shall submit detail drawings, including design computations, to the GROUP's REPRESENTATIVE and REMEDIAL DESIGNER for approval.

1.08 PROTECTION OF PEOPLE AND PROPERTY

- A. CONTRACTOR shall plan and conduct its operations and take all necessary precautions to prevent damage to existing utilities, structures, roads, grades, slopes, surface water drainage features, underground piping, manholes, monitoring wells, piezometers, and other site features; to safeguard people and property; to minimize traffic inconvenience; to minimize dust and odors; and to provide safe working conditions. The CONTRACTOR shall repair, to the GROUP's REPRESENTATIVE's satisfaction, and at no additional expense or delay to the GROUP, any and all damage which occurs as a result of the excavation work.

PART 2 – PRODUCTS

2.01 STEEL SHEET PILING

- A. Steel sheet piles shall be hot-rolled, and conform to ASTM A572/A572M, Grade 50.
- B. Provide and install AZ-18, or approved equivalent, steel sheet pile sections. These sheet piles shall have minimum effective Section Modulus (S_{xx}) and Moment of Inertia (I_{xx}) values of 48.3 in³/foot and 406.5 in⁴/foot, respectively.
- C. All steel sheet piling shall be installed at the locations and to the depths shown on the Contract Drawings.
- D. Sheet piling interlocks shall be free-sliding, provide swing angles suitable for the intended installation, but not less than three (3) angular degrees when interlocked, and maintain continuous interlocking when installed.

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2.02 APPURTENANT MATERIALS

- A. Metal plates, shapes, bolts, nuts, rivets, and other appurtenant fabrication and installation materials shall conform to Manufacturer's standards, and to the requirements specified in the respective sheet piling standards.
- B. Structural and miscellaneous steel shall conform to ASTM A36/A36M.

PART 3 – EXECUTION

3.01 ALIGNMENT AND TOLERANCES

- A. The CONTRACTOR shall furnish necessary surveying services for establishing sheet piling locations, in accordance with Section 01050 of these Technical Specifications.
- B. Any sheet piles driven/installed more than three (3) inches from the locations indicated on the CONTRACTOR's approved steel sheet piling shop drawings will be rejected.
- C. Sheet piling shall be driven plumb, and shall not deviate from the vertical by more than 1/8-inch-per-foot. If at any time, the sheet piles are found to be out of plumb the CONTRACTOR shall immediately take corrective measures to bring the effected sheet piles back into specified tolerances to ensure plumbness of the succeeding piles are not effected.
- D. Prior to undertaking any corrective measures, CONTRACTOR shall submit its proposed methods, to the REMEDIAL DESIGNER for approval, to correct sheet pile sections that are out of alignment or plumbness. All corrective measures shall not compromise the capability of the interlocks.
- E. The Contractor shall provide suitable guide structures to ensure that piles and driving equipment are properly aligned during driving. Guide structures shall be equipped with suitable devices to avoid damaging protective coating of sheet piles, as necessary.
- F. Costs associated with corrective actions and/or removing/re-driving of rejected sections of steel sheet piling shall be at the CONTRACTOR's own cost, and not reimbursed by the GROUP.

3.02 DRIVING

- A. Sheet piles shall be driven in sections and sequence as may be indicated on the Contract Drawings and as specified herein.

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- B. Prior to driving sheet piles, existing obstructions and utilities shall be located and removed.
- C. No sheet piles shall be driven within fifty (50) feet of newly placed concrete which is less than forty-eight (48) hours old.
- D. All steel sheet piles shall be driven to the minimum tip elevations indicated on the Contract Drawings.
- E. Protective caps shall be used during driving operations, as required by the REMEDIAL DESIGNER, to prevent damage to the top of the sheet piles.
- F. Sheet piling driven to the required depth and extending above the specified top of wall elevations, as indicated on the Contract Drawings, shall be trimmed off at the top of wall elevation noted on the Contract Drawings. The Contractor shall trim the tops of all damaged sheet piles, which interfere with the driving activities or detrimentally affect appearance, if exposed in the finished work.
- G. If piles driven to the required depth are too short to reach the required top elevation, said effected sheet piles shall be extended by splicing. CONTRACTOR shall submit its splicing procedures, as necessary and as part of its shop drawing submission.
- H. Each sheet pile shall be interlocked with adjoining sheet piles for its entire length. Where ball and socket interlocks are indicated on the Contract Drawings, piles shall be driven with the ball edge leading. Sheet piles driven out of interlock with adjacent sheet piles shall be removed and replaced with new sheet piles.
- I. If the driving of a sheet pile tends to drag an adjacent sheet pile below grade, it shall be reported to the REMEDIAL DESIGNER, prior to taking any corrective actions. Corrective actions shall be as approved by the REMEDIAL DESIGNER.
- J. Jetting of steel sheet pile section will not be permitted on this project.
- K. Where boulders or other obstructions render it impracticable to drive sheet piles to the required depth, CONTRACTOR shall stop further driving, and submit its procedures to remove the obstructions or propose a re-designed configuration.
- L. Contractor shall maintain and submit records of driving. Driving records shall include alignment and verticality checks, location of splices and inspection of splice welds, and shall note driving equipment used and locations and depths where difficulty in driving was encountered.

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- M. The hammer selected to drive the sheet piles shall be shown to limit the induced stresses in the sheet piles to less than 90% of the yield stress of the pile material.
- N. Each pile section (or pair of sheets) shall not be driven more than five (5) feet ahead of the adjacent sections.
- O. Open socket ends shall be kept free of soil during driving.

3.03 SPLICES

- A. Splices in sheet piling, as approved by the REMEDIAL DESIGNER, shall be full-penetration butt-welded. No more than one (1) splice per sheet will be allowed. When adjacent piles are to be spliced, splices shall be staggered not less than ten (10) feet apart in elevation.
- B. Splices shall be fabricated to assure alignment of the spliced parts. Change in slope between parts spliced shall not exceed 1/500.
- C. The Contractor shall utilize welding procedure in accordance with AWS D1.1. The Contractor shall provide inspection of welding, and shall submit qualification records of welders and welding procedures.

3.04 SEALING

- A. All handling holes in the sheet pile shall be sealed using steel plate having the same thickness as the sheet pile. Steel plate shall be seal welded all around.
- B. All exposed interlock joints shall be sealed using Volclay Joint Seal as manufactured by American Colloid Company or approved equal. Application of joint seal shall be in accordance with the manufacturer's recommendations.

*****END OF SECTION*****

SECTION 02590

GEOMEMBRANES

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. CONTRACTOR shall furnish all materials, labor, equipment, tools and appurtenances required to install the very flexible polyethylene (VFPE) geomembrane for the cap as shown on the Contract Drawings. VFPE is a broad classification of materials which includes linear low-density polyethylene (LLDPE) and low-density linear polyethylene (LDLPE).
- B. Textured (double-sided), VFPE shall be installed on all slopes.
- C. Installation of the VFPE geomembrane shall be completed by an experienced specialty SUBCONTRACTOR (Installer) fully qualified to complete the portions of the Work as specified in this Section. Reference to the CONTRACTOR implies Installer as appropriate in this Section.
- D. CONTRACTOR shall be responsible for the manufacturing, transport, and installation of the geomembrane cover components of the cap. The CONTRACTOR, as assisted by the Installer, shall provide Shop Drawings and a written description detailing the proposed methods to be employed for performing the Work. All materials, equipment, and supplies to be incorporated into the Work shall be described, including seaming plans, boots/sleeves/skirts for cap penetrations, installation procedures, quality control programs, and any other information needed to show the proposed method of conforming to the Contract Documents.
- E. A pre-installation meeting shall be held between the CONTRACTOR, Installer, GROUP's REPRESENTATIVE, REMEDIAL DESIGNER, and the QUALITY ASSURANCE OFFICER (QAO) at least two (2) workdays prior to beginning the deployment of the VFPE geomembrane.
- F. Comply with applicable codes, ordinances, rules, regulations and laws of local, municipal, state or federal authorities having jurisdiction.

1.02 RELATED SECTIONS

- A. Section 02210 – Site Grading
- B. Section 02223 – Backfill and Fill
- C. Section 02224 – Cover Soil
- D. Section 02598 – Geosynthetic Clay Liner
- E. Section 02599 – Geocomposite Drainage Layer

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1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
2. ASTM D792 - Standards Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
3. ASTM D1004 - Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
4. ASTM D1505 - Standard Test Method for Density of Plastics by Density-Gradient Technique.
5. ASTM D1603 - Standard Test Method for Carbon Black in Olefin Plastics.
6. ASTM D4218 - Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
7. ASTM D4437-84 - Standard Practice for Determining Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes.
8. ASTM D4833-88 - Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
9. ASTM D5199-91 - Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
10. ASTM D5397 - Procedure to Perform a Single Point Notched Constant Tensile Load - Appendix (SP-NCLT) Test
11. ASTM D5596 - Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
12. ASTM D5641 – Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
13. ASTM D5820 – Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes.
14. ASTM D5994 - Test Method for Measuring the Core Thickness of Textured Geomembranes.
15. ASTM D6365 – Standard Practice for Nondestructive Testing of Geomembrane Seams using the Spark Test.
16. ASTM D6392 – Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
17. ASTM D6497 – Standard Guide for Mechanical Attachment of Geomembranes to Penetrations or Structures.

B. Geosynthetic Research Institute (GRI):

1. GRI Test GM-10 - Specification for Stress Crack Resistance of Geomembrane Sheet.
2. GRI Test GM-12 - Measurement of Asperity Height of Textured Geomembrane Using a Depth Gage.

C. United States Environmental Protection Agency:

1. Technical Guidance Document "Quality Assurance and Quality Control for Waste Containment Facilities," EPA/600/R-93/182, September 1993, 305 pp.
2. "Lining of Waste Containment and Other Impoundment Facilities," EPA/600/2-88/052.

1.04 SUBMITTALS

- A. CONTRACTOR shall submit to the GROUP's REPRESENTATIVE, QAO, and REMEDIAL ENGINEER all items described in subsequent sections as outlined by the following schedule:

Prior to Delivery to the Project Site

1. Manufacturer's Product Specifications.
2. Manufacturer's quality control certificates for each geomembrane roll to be delivered to the Site.
3. Quality control documentation required by Article 2.04 of this Section.

Prior to Installation

1. Resumes of all CONTRACTOR/INSTALLER geomembrane installation personnel on-Site indicating prior polyethylene geomembrane installation experience, and identification of the Superintendent, Master Seamer, and Quality Control Technician. CONTRACTOR/INSTALLER personnel shall be subject to approval by the GROUP's REPRESENTATIVE and the QAO.
2. Shop drawings, including geomembrane panel layout drawings and details of all work, including fusion and extrusion welding processes.
3. Schedule of operations, including means and methods of installation.
4. Completed Certificates of Subgrade Acceptance.

Daily During Installation

1. Daily construction progress reports clearly showing geomembrane panels placed by date.
2. Daily seam test records, including seamer trial seam testing.
3. Daily records of field seam testing (destructive and non-destructive) for the geomembrane.

Upon Completion

1. Record panel layout diagram (4 prints and 1 reproducible).
2. Summary and log of all laboratory quality control testing completed by the CONTRACTOR/INSTALLER.

3. Summary and log of all field quality control testing completed by the CONTRACTOR/INSTALLER.
4. Certification that material installation is complete and in accordance with the Specifications.
5. Statement of material warranty from the geomembrane manufacturer.
6. Statement of workmanship warranty from the CONTRACTOR/INSTALLER.

B. Submit in accordance with Section 01300 of these Technical Specifications.

1.05 MATERIAL TRANSPORT

- A. CONTRACTOR/INSTALLER shall be responsible for the protection of the geomembrane rolls against damage during transportation to the Site, during storage at the Site, and prior to placement of subsequent or adjacent construction materials.
- B. Only undamaged geomembrane shall be included within the construction. Any damaged material, as determined by the QAO, shall be replaced by the CONTRACTOR/INSTALLER at no additional cost to the GROUP.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Conform to the manufacturer's requirements to prevent damage to geomembrane during delivery, storage, and handling.
- B. Delivery
 1. Deliver materials to the Site only after the QAO approves required submittals.
 2. Separate any damaged rolls from undamaged rolls and store at locations designated by the QAO until damaged rolls are removed from Site.
 3. The QAO shall be the final authority regarding damage.
 4. Separate rolls without proper documentation and store until QAO approval is received.
- C. On-Site Storage
 1. Store all materials in an area designated by the QAO.
 2. Protect from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, and other potential damage.
 3. Store on a level prepared surface (not on wooden pallets).
 4. Stack rolls in accordance with the manufacturer's recommendation but no more than three rolls high.
- D. On-Site Handling
 1. CONTRACTOR/INSTALLER shall use appropriate handling equipment to load, move and deploy geomembrane rolls. Appropriate handling

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- equipment includes cloth chokers and spreader bar for loading, and spreader and roll bars for deployment. Dragging or rolling panels on the ground surface shall not be permitted.
2. Folding of the geomembrane sheet shall not be permitted and shall be a basis for rejection.
 3. CONTRACTOR/INSTALLER shall be responsible for off-loading, storage, and transporting material from the storage area to the area to be lined.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. The manufacturer of the geomembrane sheet must be approved by the REMEDIAL DESIGNER and GROUP's REPRESENTATIVE, and have satisfactory experience in extruding VFPE geomembrane materials with a reputation for producing a high quality product.
- B. CONTRACTOR shall submit the manufacturing company name, address, telephone number, and employee contact to the REMEDIAL DESIGNER, QAO, and GROUP's REPRESENTATIVE.

2.02 RESINS

- A. Geomembrane sheet shall be manufactured from virgin polyethylene resin having a minimum density of 0.915 g/cm^3 . The resin shall be mixed with two (2) to three (3) percent carbon black. Polymer reclaimed during the manufacturing process may be permitted if done with an appropriate cleanliness and if the reclaimed polymer does not exceed two (2) percent by weight. The carbon black is to be pre-blended according to specifications of the manufacturer. While more than one resin type may be suitable and will be considered, CONTRACTOR is cautioned that resin selection is crucial to the successful completion of the project and proposed resins will be most thoroughly and carefully reviewed.
- B. Prior to the delivery of the geomembrane material to the Site, CONTRACTOR/INSTALLER will be required to provide the QAO with a written certification from the manufacturer that the product to be delivered has been extruded from an approved resin. This certification shall include the origin (resin supplier's name and resin production plant), identification (brand name and number), resin production date, and quality control certificates issued by the resin supplier. No material will be permitted to be stored on Site until this certification has been delivered to and approved by the QAO.

2.03 PHYSICAL PROPERTY REQUIREMENTS

- A. Geomembrane sheet shall be formulated from the appropriate polymers and compounding ingredients to form a polyethylene sheet material that meets all

requirements for the specified end use of the product. The sheet material shall be capable of being bonded to itself by thermal bonding in accordance with the manufacturer's recommendations and instructions, and the seaming requirements of this section.

- B. Extruded sheets shall be at least fifteen (15) feet in width. Each roll shall be identified by a number and date of manufacture. Labels or markers used for identification shall be of a type which will not degrade the liner material. The labels shall contain, at a minimum, the following information:

1. Manufacturer's name.
2. Product identification.
3. Nominal thickness.
4. Roll Number.
5. Lot/Batch Number.
6. Roll Dimensions.

- C. The delivered textured VFPE geomembrane sheets for construction of the cover system shall conform to the following minimum properties:

Property	Test Method	Value	Units
1. Thickness (min. average)	ASTM D5199	40	mil
Thickness (min. reading)		36	mil
2. Sheet Density (min.)	ASTM D792	0.915	g/cm ³
Sheet Density (max.)	or ASTM D1505	0.939	g/cm ³
3. Tensile Properties ¹	ASTM D638		
a. Strength at Break (min.)		152	ppi
b. Elongation at Break (min.)		800	%
4. Tear Resistance (min.)	ASTM D1004 Die C	22	lbs.
5. Puncture Resistance (min.)	ASTM D4833	56	lbs.
6. Axi-Symmetric Strain Break Resistance Strain (min.)	ASTM D5617	30	%
7. Carbon Black Content ³ (Allowable Range)	ASTM D1603	2.0-3.0	%
8. Carbon Black Dispersion ³	ASTM D5596	1, 2, 3	Category
9. Oxidative Induction Time ⁴ (OIT) (min. ave.)			
Standard OIT or	ASTM D3895	100	hours
High Pressure OIT	ASTM D5885	400	hours
10. Oven Aging at 85°C ⁵	ASTM D5721		
Standard OIT (min. ave.)			
% retained after 90 days	ASTM D3895	35	%
High Pressure OIT (min. ave)			
% retained after 90 days	ASTM D5885	60	%

<u>Property</u>	<u>Test Method</u>	<u>Value</u>	<u>Units</u>
11. UV Resistance ⁶ Standard OIT (min. ave.) or High Pressure OIT (min. ave) % retained after 1600 hours ⁸	ASTM D3895 ASTM D5885	N.R. ⁷ 35	
12. Bonded Seam Strength (min.)	ASTM D6392	60 ⁹	lbs./inch
13. Peel Adhesion a. Fusion Seams (min.) b. Extrusion Seams (min.)	ASTM D6392	50 ¹⁰ 50 ¹⁰	lbs./inch lbs./inch

¹Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of five (5) test specimens each direction.

Break elongation is calculated using a gage length of 2.0 inches at 2.0 inches per minute

²Other methods such as ASTM D4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation can be established.

³Carbon black dispersion (only near spherical agglomerates) for ten (10) different views:

Minimum 9 of 10 in Categories 1 or 2

All 10 in categories 1, 2, or 3

⁴The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane

⁵It is also recommended to evaluate samples at thirty (30) and sixty (60) days to compare to the ninety (90) day response

⁶The condition of the test should be twenty (20) hour UV cycle at 75°C followed by four (4) hour condensation at 60°C.

⁷Not recommended since the high temperature of the Standard OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples

⁸UV resistance is based on percent retained value regardless of the original high pressure OIT value

⁹Sheet shall yield before failure of the seam.

¹⁰Seam separation shall not extend more than ten (10) percent into the seam. Testing shall be discontinued when the sample has visually yielded. Sample shall conform to a passing configuration as outlined in Figures 3 (double wedge fusion) and 4 (fillet extrusion) of ASTM D6392.

2.04 QUALITY CONTROL DOCUMENTATION

A. Prior to installation of any geomembrane, the manufacturer or CONTRACTOR shall provide the QAO with the following documentation:

1. The origin (supplier's name and production plant), identification (brand name and number), and production date of resin used to manufacture the geomembrane.
2. Copies of dated quality control certificates issued by the resin supplier.

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3. Results of tests conducted by the manufacturer to verify that the resin used to manufacture the geomembrane meets the project specifications.
4. A statement from the manufacturer indicating that the amount of reclaimed polymer added to the resin during manufacturing does not exceed two (2) percent and was done with appropriate cleanliness.
5. A list of materials which comprise the geomembrane, expressed in the following categories as percent by weight: polyethylene, carbon black, and other additives.
6. Specifications for the geomembrane which includes all properties listed in Article 2.03 of this Section measured using the specified test methods.
7. Written certification that the minimum values given in the specification are guaranteed by the manufacturer.
8. Quality control certificates, signed by a responsible party employed by the manufacturer, indicating product designation, roll number identification, date of manufacturer, resin batch identification, testing procedures, and the results of all quality control tests. At a minimum, the tests listed in Articles 2.04.B and 2.04.C shall be performed, as applicable.

- B. The following quality control tests, at a minimum, shall be performed and test results reported by the manufacturer for textured VFPE geomembrane:

<u>Test</u>	<u>Method</u>	<u>Min. Frequency</u>
Thickness	ASTM D5199	1/roll
Density	ASTM D792/D1505	1/50,000 ft ²
Tensile Properties	ASTM D638	1/50,000 ft ²
Tear Resistance	ASTM D1004 Die C	1/50,000 ft ²
Puncture Resistance	ASTM D4833	1/50,000 ft ²
Carbon Black Content	ASTM D1603	1/50,000 ft ²
Carbon Black Dispersion	ASTM D5596	
1/50,000 ft ²		
Stress Crack Resistance	ASTM D5397	1/resin lot

- C. Interface friction angles of textured VFPE geomembranes, as specified in the Contract Documents, shall be determined by the CONTRACTOR, based on the compatibility with the geosynthetic interface materials (geosynthetic clay liner and geocomposite), as selected by the CONTRACTOR, that the geomembranes will be in contact with. CONTRACTOR shall employ an independent laboratory for this interface friction angle testing. The test shall be performed in accordance with ASTM D5321 under saturated conditions with confining pressures over the range of 100 to 500 psf. The soil component shall be compacted to a maximum 85 percent of the Standard Proctor maximum dry density, as determined by ASTM D698. At least three (3) tests shall be performed over this specified range of confining pressures to determine the friction angle.
- D. All quality control test results shall be reviewed by the QAO for conformance with the minimum properties listed in Article 2.03 of this Section. Any nonconformance shall be reported to the GROUP's REPRESENTATIVE and shall be the basis of rejection of the nonconforming rolls.

2.05 CONFORMANCE TESTING

- A. Upon delivery of the material to the Site, the QAO shall obtain conformance test samples from selected geomembrane rolls to verify conformance with the project specifications. Alternatively, samples may be obtained at the manufacturing facility prior to material delivery to the Site, if desired by the GROUP's REPRESENTATIVE.
- B. Samples shall be three (3) feet by the entire width of the roll and shall be obtained after the first three (3) feet (or more if material is damaged as determined by the QAO) of the roll has been removed. Samples shall be marked with "machine direction" indicated prior to shipment to the laboratory.
- C. Conformance testing shall be performed by a qualified geosynthetic materials testing laboratory approved by the GROUP's REPRESENTATIVE and the QAO.
- D. The following conformance tests shall be performed for textured VFPE geomembrane:

<u>Test</u>	<u>Method</u>	<u>Min. Frequency</u>
Thickness	ASTM D5199	1/100,000 ft ²
Density	ASTM D792/D1505	1/100,000 ft ²
Tensile Properties	ASTM D638	1/100,000 ft ²
Tear Resistance	ASTM D1004 Die C	1/100,000 ft ²
Puncture Resistance	ASTM D4833	1/100,000 ft ²

<u>Test</u>	<u>Method</u>	<u>Min. Frequency</u>
Carbon Black Content	ASTM D1603	1/100,000 ft ²
Carbon Black Dispersion	ASTM D5596	
1/100,000 ft ²		

- E. All conformance test results shall be reviewed by the QAO for conformance with the minimum physical properties listed in Article 2.03 of this Section. Any nonconformance shall be reported to the GROUP's REPRESENTATIVE and shall be the basis of rejection of the nonconforming rolls.
- F. If a test result does not meet the project specifications, all material from the resin batch represented by the failing sample shall be considered out-of-specification and rejected. Alternatively, at the option of the GROUP's REPRESENTATIVE, additional conformance test samples may be taken to bracket the portion of the batch not meeting the specification. This procedure is valid only when all rolls in the batch are consecutively produced and numbered from one manufacturing line. To isolate out-of-specification material, additional samples shall be taken from rolls which have numbers immediately adjacent (or the next roll number present on-Site from the same batch) to the roll that was initially sampled and failed. If both additional tests pass, the roll that represents the initial failed test and the roll manufactured immediately after that roll (next larger roll number), if present on-Site, shall be rejected. If one or both of the additional tests fail, then the entire

batch shall be rejected or this procedure repeated with two additional tests that bracket a greater number of rolls within the batch. All additional testing shall be at the cost to the manufacturer.

2.06 EQUIPMENT

A. Welding Equipment and Accessories

1. Welding devices shall be equipped with gauges showing temperatures both in the device and at the nozzle.
2. An adequate number of welding devices shall be maintained on the Site to avoid delaying work.
3. Power sources used for equipment shall be capable of providing constant voltage under combined-line load.
4. Portable electric generators used on the geomembrane shall be equipped with a splash pad to contain spilled fuel.

B. Field Tensiometer

1. CONTRACTOR shall provide a calibrated field tensiometer capable of quantitatively measuring geomembrane seam strength. CONTRACTOR shall submit to the QAO a certificate of calibration indicating calibration within the last year.
2. The tensiometer shall be equipped with a gauge accurate to within ± 2 pounds per inch of specimen width.
3. CONTRACTOR shall maintain the required die cutters for preparation of test specimens.

PART 3 – EXECUTION

3.01 GENERAL

- A. CONTRACTOR/INSTALLER shall have previous experience in the installation of polyethylene geomembrane, and will be required to provide satisfactory evidence demonstrating the successful installation of a total of at least five-hundred (500) acres of polyethylene geomembrane on at least ten (10) projects of similar size and scope.
- B. At a minimum, CONTRACTOR/INSTALLER shall designate a Superintendent and a Master Seamer for the project. The Superintendent shall have a documented experience of installation of at least one-hundred (100) acres of previous capped or comparable geosynthetic systems, on a minimum of five different projects. The Master Seamer shall have at least 1,000,000 square feet of polyethylene geomembrane seaming experience using the methods required for this project and shall have worked on at least two previous projects. CONTRACTOR/INSTALLER shall provide satisfactory evidence demonstrating

these requirements are met. The CONTRACTOR/ INSTALLER shall provide resumes for all installation personnel.

- C. CONTRACTOR/INSTALLER shall present a schedule of operations to the QAO and obtain the QAO's approval in writing of the same. This schedule shall be submitted sufficiently in advance of the proposed work as to afford a reasonable amount of time for the QAO to review and approve the schedule. The CONTRACTOR/INSTALLER shall attend a pre-construction meeting at the Site with representatives of the GROUP and the QAO to discuss project procedures, schedule, sequence of installation, and personnel to be used.
- D. CONTRACTOR/INSTALLER shall comply with all required submittals listed in Article 1.04 of this Section prior to geomembrane installation, including all material quality control documentation and a geomembrane panel layout drawing(s). All submittals require the review and written approval by the QAO prior to installation.
- E. Prior to geomembrane installation, CONTRACTOR/INSTALLER shall provide the QAO a panel drawing indicating the proposed geomembrane panel layout. This drawing shall be in sufficient detail to provide an accurate representation of the field seaming that will be performed. Any revision to the panel drawing shall be approved by the QAO prior to future installation operations.
- F. CONTRACTOR/INSTALLER shall prepare daily reports summarizing the day's activities and a copy shall be provided to the QAO by 12:00 Noon the following work day. CONTRACTOR/INSTALLER shall prepare a standard daily report form for approval by the QAO prior to commencement of geomembrane installation. These reports will contain, at a minimum, the following items:
 - 1. Weather conditions.
 - 2. Areas worked.
 - 3. Daily production (quantities installed and seam lengths).
 - 4. Personnel on Site.
 - 5. Equipment used.
 - 6. Type and results of quality control testing completed by the CONTRACTOR/INSTALLER, including results of all non-destructive seam strength tests.
 - 7. Results of all destructive seam tests received from the QAO.
 - 8. Documentation of tracking, repair, and testing of all seams reconstructed as a result of failed non-destructive or destructive testing.
 - 9. Problems encountered during construction.
 - 10. Resolution of problems.
- G. The QAO shall provide at least one representative to observe installation of the geomembrane. If CONTRACTOR/INSTALLER wishes to concurrently perform two or more activities, which require observation by the QAO (i.e., pre-seaming preparation, seaming, non-destructive seam testing, and repairs), CONTRACTOR/INSTALLER must submit in writing to the QAO, a request for

additional representatives no less than forty-eight (48) hours in advance of any such construction activities.

- H. CONTRACTOR/INSTALLER shall inform the QAO of his planned construction activities at the commencement of each work day.

3.02 SUBGRADE PREPARATION

- A. A suitable subgrade shall be prepared for geomembrane.
- B. CONTRACTOR/INSTALLER and QAO shall approve the subgrade before geomembrane installation. No geomembrane shall be placed over unsuitable or unapproved subgrade. The CONTRACTOR/INSTALLER shall furnish a signed Certificate of Subgrade Acceptance prior to the installation over a particular area indicating acceptance of the subgrade in that area. The following conditions shall be minimum for the subgrade:
 - 1. No stones or sharp objects shall be present on the area to be lined.
 - 2. The subgrade surface shall have a smooth, finished surface. The surface should not be pebbly or tracked and rutted by equipment and shall be free from pockets, holes, and discontinuities which will cause bridging which would, in the judgment of the QAO, overstress the geomembrane.
 - 3. The surface shall not be excessively wet or dry or in any condition which will impede proper installation. Under no circumstances shall the geomembrane be placed over standing water on the subgrade.
 - 4. The underlying geosynthetic clay liner shall be in-place and accepted by the QAO prior to installation of the geomembrane.

3.03 PANEL DEPLOYMENT

- A. Geomembrane panels shall be installed to the configuration shown on the approved panel layout diagram. The proposed layout of panels shall be approved by the QAO, assuring efficiency of material and minimization and proper placement of seams. Any variation from the panel diagram must be approved by the QAO prior to installation of such panels. Should a variance be obtained, the CONTRACTOR/INSTALLER shall modify the panel diagram to show the record configuration following installation. The prime considerations in seaming shall be to minimize the number of seams made under unfavorable conditions. All overlaps for field seams shall be shingled in a downslope direction to the maximum extent practical.
- B. Panels shall be unrolled in a manner which does not cause scratches or crimps in the geomembrane and which does not damage the prepared subgrade. Panels shall be placed to conform to the subgrade. All panels shall be anchored properly at the top of slope and pulled taught to minimize wrinkles. Any wrinkles between panels shall be removed prior to seaming.
- C. Panels shall be held down temporarily along exposed edges until seamed to prevent uplift from wind. Acceptable methods of holding down the geomembrane include

sand bags, tires, or other suitable weights which will not damage the geomembrane, subject to approval by the QAO. Geomembrane which becomes damaged during installation due to wind or weather prior to covering shall be replaced by the CONTRACTOR/INSTALLER at no additional cost to the GROUP.

- D. Panels shall be staggered such that cross seams between panels are not continuous throughout the cover area. Panels shall be installed such that no horizontal seams are constructed on slopes steeper than ten percent.
- E. All panel overlaps within an area of slope steeper than ten percent shall be made parallel to the direction of maximum slope (i.e., the uphill panel shall overlap the downhill panel). Horizontal seams on slopes less than ten (10) percent shall be at least five (5) feet away from the toe and crest of any slopes steeper than ten (10) percent.
- F. Each geomembrane panel shall be marked with a unique panel number. The numbering system shall be simple and logical and panels shall be consecutively numbered based on the order of installation.
- G. The number of panels deployed in one day shall be limited by the number of panels which can be seamed or tack welded on the same day.
- H. Installation of individual geomembrane panels shall result in a good fit (thermal expansion or contraction shall be considered), without bridging in all corners and grade changes. Excessive slack shall be avoided to minimize wrinkles during the placement of the geotextile, geocomposite and the protective cover soil.
- I. Geomembrane shall not be installed when ambient air temperature measured six (6) inches above the geomembrane, is below 32°F or above 104°F, when the sheet temperature exceeds 160°F, during precipitation, or when winds exceed twenty (20) mph, unless the CONTRACTOR/INSTALLER submits acceptable evidence to the QAO that his performance standards can be maintained under these conditions. Trial seam and destructive testing frequencies may be increased at the discretion of the QAO if installation is permitted under these circumstances.
- J. CONTRACTOR/INSTALLER shall use appropriate methods, to be approved by the QAO, necessary to prevent water or wind from getting under the installed geomembrane. Should excessive moisture become trapped below the geomembrane or wind damage incur, the CONTRACTOR/INSTALLER, at no additional cost to the GROUP, shall be required to repair all work, including removing and replacing as much of the installed geomembrane as the QAO directs, to assure that the integrity of the geomembrane and the underlying subgrade has not been compromised.
- K. To avoid confusion, CONTRACTOR/INSTALLER and QAO shall each use different colored markers that are readily visible for writing on the geomembrane. The markers used shall be semi-permanent and compatible with the geomembrane.

The CONTRACTOR/INSTALLER shall use white markers while the QAO shall use yellow markers. No other parties shall be permitted to write on the geomembrane.

- L. Pedestrian and equipment activity over the geomembrane shall be kept to a minimum and restricted to that which is necessary for installation. Installation personnel shall take precautions not to damage the geomembrane surface. All personnel working on the geomembrane shall wear smooth-soled shoes. Construction and other Site personnel shall be informed of the restricted access to areas of geomembrane placement. Barriers and signs shall not be permitted on the geomembrane prior to placement of soil cover.
- M. No tracked equipment or other equipment which may pose a risk of puncturing, tearing or otherwise damaging the geomembrane or geosynthetic clay liner shall be permitted for use in installation of the geomembrane or during placement of geocomposite directly over the exposed geomembrane.
- N. Use of glass bottles and smoking in the geomembrane installation area shall not be permitted. Care shall be taken to avoid dragging tools across the geomembrane surface; all large tools shall have smooth base plates or shoes. Use of clamps and other tools shall be restricted and used with care to avoid damaging the geomembrane.

3.04 FIELD SEAMING

- A. Geomembrane field seams shall be one of the following types:
 - 1. Double Hot Wedge (Fusion): This seam is produced by melting to two intimate surfaces by running a hot metal wedge between the surface followed immediately by pressure to form a homogeneous bond. This seam has an integral air channel for non-destructive testing of the seam. All areas, which are to become seam interfaces shall be free of dust, dirt and moisture.
 - 2. Extrusion Weld: This seam is produced by extruding molten parent polyethylene resin between or at the edge of two overlapped geomembrane panels. A bonded seam is completed when extruded hot resins melt adjacent sheet resins to form a homogeneous weld. All areas which are to become seam interfaces shall be properly ground and free of dust, dirt, and moisture.
- B. Double fusion welding shall be the primary method of seaming between adjacent panels. Extrusion welding shall be a secondary method for seaming between adjacent is areas where fusion seaming is difficult or impractical, and shall be the primary method for detail work and small repair work.
- C. At least one (1) spare operable seaming apparatus shall be maintained for every three seaming crews.

- D. The Master Seamer shall be present during all geomembrane seaming and shall provide direct supervision over the seamers.
- E. No seaming device or seamer (operator) shall be permitted to commence seaming of geomembrane until a field trial seam test has been performed by the seamer using the seaming device and has passed the required trial seam test in accordance with Article 4.03 of this Section.
- F. The QAO shall visually observe all field seams and sheets as installed. Any questionable areas or observed changes in physical installation characteristics will be immediately called to the attention of the CONTRACTOR/INSTALLER's Superintendent or designated representative and reinspected with the representative. With regard to the geomembrane seams, if the area is questionable in any manner after the initial field inspection, a field sample may be required and laboratory peel and tensile tests conducted in accordance with Part 4 of this Section. While destructive sampling will be minimized, random samples of seams representing different conditions may be taken for testing to examine the weld and its effect, if any, on the adjacent material.
- G. The seam numbering system shall be consistent with the panel numbering system.
- H. Adjacent geomembrane panels shall have a nominal overlap of three (3) inches for extrusion seams and five (5) inches for fusion seams and shall be sufficient to allow for peel adhesion testing.
- I. The overlap area shall be cleaned with a soft cloth or paper towel to remove any dirt, dust, moisture, grease, or other material prior to seaming.
- J. Provide a firm, dry substrate under the seam overlap during seaming of the geomembrane. If required, use a geomembrane rub sheet, or similar hard surface, directly under the seam overlap to provide proper support of the seaming device. Use plywood or other firm material under the seam overlap when seaming over the anchor trench.
- K. For fusion seaming, a moveable protective layer, such as a geomembrane rub sheet, may be required directly below the seam overlap to prevent build-up of moisture between the sheets and to prevent debris from collecting around the pressure rollers.
- L. A smooth insulating plate or fabric shall be placed beneath the hot seaming device after usage to protect the underlying geomembrane.
- M. For extrusion seaming, clean and dry welding rod or pellets shall be used. Extrudate shall be from the same parent material as the geomembrane. All heat degraded extrudate shall be purged from the extruder prior to beginning a seam and shall be disposed outside of the geomembrane lined area.

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- N. Each extruder shoe shall be inspected by the CONTRACTOR/INSTALLER daily to check for wear to ensure that the offset is the same as the liner thickness. Worn shoes, damaged or misaligned armature brushes, nozzle contamination, pre-heat device, or other worn or damaged parts shall be repaired prior to further use.
- O. For extrusion welded seams, the following additional steps shall be performed:
 - 1. Clean oxidation from surface area of seam using disc grinder with number eighty (80) grit sandpaper within one hour of seaming.
 - 2. Bevel the edge of the upper geomembrane sheet.
 - 3. Minimize exposed grinding marks outside of extrusion weld. The roughened surface shall extend to more than 1/4-inch outside the seam area and the thickness of the sheet after grinding shall be at least ninety-five (95) percent of the original thickness.
 - 4. Use a soft bristle brush after grinding to remove loose particles. Use of wire brushes shall not be permitted.
 - 5. Recleaning and/or rebrushing of the roughened surface may be required prior to seaming.
 - 6. Patch area where excessive grinding has reduced sheet thickness to less than ninety-five (95) percent of the original sheet thickness.
- P. Start/stop extrusion welding shall be avoided.
- Q. The end of an existing extrusion weld shall be ground two (2) inches back from the point of stoppage or two (2) inches from either side of a vacuum test leak before welding. Restart extrusion welding two (2) inches back from the point of stoppage or two (2) inches from either side of a vacuum test leak.
- R. Temporary bonding for extrusion seams shall be used and shall consist of a hot air device (Leister). Care shall be taken to avoid damaging the geomembrane. Apply a nominal amount of heat to lightly tack the geomembrane panels together. Control temperature at the nozzle of the hot air device to prevent excessive heating or damage to the geomembrane.
- S. Solvents or adhesives shall not be permitted.
- T. If a wrinkle or “fishmouth” is present along an area to be seamed, the following repair procedure shall be followed:
 - 1. Cut the wrinkle along the ridge to achieve a flat overlap.
 - 2. Overlap the geomembrane along the cut.
 - 3. Extrusion weld along the overlap where the overlap exceeds 3 inches.
 - 4. Patch the cut area where the geomembrane overlap of less than 3 inches. Use an oval-shaped patch of the same geomembrane extending at least 6 inches beyond the cut area in all directions.
- U. Provide adequate supplemental lighting if seaming operations are performed at night.

- V. All cross seam tees shall be extrusion welded to a minimum distance of four (4) inches on each side of the tee. For fusion seam intersections, the flap shall be cut and the edge of the air channel shall be exposed at the end of the seam to seal the seam at the intersection.
- W. All seams shall extend through the anchor trench to the minimum dimensions shown on the Contract Drawings.
- X. CONTRACTOR shall perform quality control tests and procedures as required and indicated in Part 4 of this Section.
- Y. All seams shall be non-destructively tested using the appropriate method described in Article 4.04 of this Section. The testing method utilized by CONTRACTOR/INSTALLER does not exclude the QAO or the GROUP from performing their own tests. CONTRACTOR/INSTALLER shall work closely with the QAO in assisting them to perform independent tests or observe the testing performed by CONTRACTOR/INSTALLER. CONTRACTOR/INSTALLER is cautioned that field seaming will be thoroughly inspected. No consideration will be given for extra costs that may be incurred due to delays in the independent testing being performed by the QAO or by the GROUP's REPRESENTATIVE observing and reviewing the testing being performed by CONTRACTOR/INSTALLER.
- Z. All seams that cannot be subjected to quality control testing must be overcapped.

PART 4 – QUALITY CONTROL

4.01 GENERAL

- A. CONTRACTOR/INSTALLER shall appoint an experienced individual as the Quality Control Technician who will be responsible for supervising and/or conducting the field quality control program. The Quality Control Technician shall be on-Site at all times during geomembrane installation. This appointment shall be subject to approval by the GROUP's REPRESENTATIVE and the QAO.
- B. Before installation begins, and at least weekly thereafter, more often if determined necessary by the GROUP's REPRESENTATIVE, project coordination meetings shall be held with designated representatives of the GROUP's REPRESENTATIVE, the CONTRACTOR/INSTALLER, and the QAO, to review the following information. This information shall be submitted to the GROUP and the QAO by the CONTRACTOR in writing, during or before this meeting:
 - 1. Progress of the work.
 - 2. Adherence to the Specifications.

3. Adherence to the quality control program, including the timely submission of the pertinent forms.
 4. Planned work and methods for the ensuing week, including estimate of time remaining until completion of the work.
- C. All submittals shall be made in a timely fashion.
- D. Any changes in the proposed method of work, subcontractors to be utilized, geomembrane resin or manufacturing must be approved in advance by the QAO. The CONTRACTOR/INSTALLER assumes all responsibility relevant to providing an acceptable product.

4.02 QUALITY CONTROL DURING INSTALLATION

- A. The GROUP will engage the QAO to conduct destructive testing and oversee non-destructive testing by the CONTRACTOR/INSTALLER during the geomembrane installation as part of the quality control program.
- B. The QAO and the CONTRACTOR/INSTALLER shall visually check all material to be included in the work for transport damage and uniformity and compare sheet identification numbers with those on the quality control certificates provided by the manufacturer to assure delivery of the appropriate material.
- C. The QAO and CONTRACTOR/INSTALLER shall also visually check the geomembrane material for any signs of damage which has occurred as a result of manufacturing, transport, unloading, storage, or installation. All observed damage shall be repaired in accordance with Article 4.06 of this Section.
- D. All seams shall be observed for signs of deformation to the panels. Any seams which, in the opinion of the QAO have caused excessive deformation of the geomembrane or show visual signs of overheating of the panels, shall be repaired at no additional cost to the GROUP regardless of the result of any non-destructive or destructive testing on the seam. The deficient seam shall be cut out, the panels again overlapped and welded, or the seam overcapped.

4.03 TRIAL SEAM TESTING

- A. At the start of each work day on which seaming is to be performed, every five hours thereafter, after each break in seaming of one-hour or more, or after an equipment shutdown, a start-up field test of the seaming equipment and seamer (operator) shall be performed on a trial seam at or near the work location to verify that acceptable geomembrane seams can be produced under existing ambient conditions. The trial seam shall be a minimum of seven feet in length as measured along the seam for self-propelled (fusion) seaming devices, and a minimum of five feet for hand-held (extrusion) seaming devices. Seam overlap shall be as specified in Article 3.04.H of this Section. The material for the trial seams and the field testing equipment shall be provided by the CONTRACTOR/INSTALLER at no additional cost to the GROUP.

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- B. A total of three specimens shall be cut from the trial seam using a 1-inch-wide die cutter, with the seam centered parallel to the specimen width. Specimen locations shall be selected at random along the test seam. Two specimens shall be tested for peel adhesion (peel) and the third specimen shall be testing for bonded seam strength (shear) in accordance with ASTM D6392. For peel testing of double fusion seams, both tracks of the seam shall be tested. Testing shall be conducted in the field by the CONTRACTOR/INSTALLER using a calibrated tensiometer and observed and documented by the QAO. Testing shall be performed at a constant jaw separation rate of twenty (20) inches per minute. Pass criteria are specified in Article 2.03.C of this Section for smooth VFPE geomembrane and in Article 2.03.D of this Section for textured geomembrane. In addition to not meeting these specified criteria, a trial seam shall be considered a failure if, upon visual inspection, the weld shows:
1. Excessive deformation; stepping of the bottom sheet when viewed in cross section.
 2. Discoloration of the sheet.
 3. Inadequate or excessively narrow or flat weld bead.
 4. Water blisters in weld bead.
 5. Misaligned weld bead, i.e. seam not reasonably centered with respect to overlap.
 6. Thinning of the sheet adjacent to the weld.
- C. If a trial seam fails as described in Article 4.03.B above, the entire trial seam operation shall be repeated. If the second attempt fails, the seaming apparatus and seamer shall not be accepted and shall not be used for seaming until the deficiencies which caused the failures are corrected and two consecutive successful trial seams are completed.
- D. CONTRACTOR/INSTALLER shall provide a calibrated tensiometer for making the specified tests in the field in accordance with Article 2.06.B of this Section.

4.04 NON-DESTRUCTIVE SEAM TESTING

- A. The QAO and CONTRACTOR/INSTALLER shall visually inspect all geomembrane seams. In addition, the CONTRACTOR/INSTALLER shall test all seams along the entire length, in the manner approved prior to installation.
- B. For non-destructive seam testing of extrusion seams, the vacuum box method shall be used in general accordance with the procedures in ASTM D5641. The vacuum test shall be performed concurrently with seaming as work progresses, not at the completion of all seaming. The vacuum box assembly consists of the following:
1. Rigid housing.
 2. Transparent viewing window.
 3. Soft rubber gasket attached to bottom of housing.
 4. Porthole or valve assembly.
 5. Vacuum gauge.

Also required are a vacuum pump and tank receiver equipped with pressure controller and pipe connections, rubber pressure/vacuum hose with fittings and connections, clean, dry, soft rags, plastic bucket and applicator, and water and detergent to produce soapy solution.

- C. The procedure for vacuum testing is as follows:
1. Clean window, gasket surfaces, and check for leaks.
 2. Energize vacuum pump and reduce tank pressure to between four (4) pounds per square inch (psi) and eight (8) psi.
 3. Wet a strip of geomembrane approximately twelve (12) inches by thirty (30) inches (length of box) with soapy solution.
 4. Place box over wetted area and compress.
 5. Close bleed valve and open vacuum valve.
 6. Ensure that a leak tight seal is created.
 7. For a period of not less than ten (10) seconds, examine length of weld through viewing window for presence of soap bubbles.
 8. If no bubbles appear after ten (10) seconds, close vacuum valve and open bleed valve, move box over next adjoining area with minimum three inches overlap and repeat process.
 9. Areas where soap bubbles appear shall be marked and repaired in accordance with Articles 3.04.Q and 4.06 of this Section, and retested until all leaks are satisfactorily repaired as indicated by passing non-destructive testing.
- D. The procedure at locations where seams cannot be non-destructively tested by a vacuum box is:
1. Where possible, cap-strip seams with same geomembrane.
 2. If seam is accessible to testing equipment prior to final installation, non-destructively test seam prior to final installation.
 3. Seaming and cap-stripping operations shall be observed by QAO for uniformity and completeness.
- E. For double hot wedge (fusion) seams, air pressure testing shall be conducted in general accordance with the procedures in ASTM D5820. Air pressure testing shall be performed concurrently with seaming as work progresses, not at the completion of all seaming. The equipment is comprised of the following:
1. Air pumps equipped with pressure gauge capable of generating and sustaining a pressure between twenty-five (25) to thirty (30) psi and mounted on a cushion to protect the geomembrane.
 2. Rubber hose with fittings and connections.
 3. Sharp hollow needle or other pressure feed device approved by the Operator.
 4. A pressure gauge with an accuracy of one (1) psi.

F. The procedure for air pressure testing is as follows:

1. Seal both ends of the seam to be tested.
2. Insert a needle or other approved pressure feed device into air channel created by the double hot wedge fusion seam.
3. Insert a protective cushion between the air pump and the geomembrane.
3. Pressurize the air channel to twenty-five (25) to thirty (30) psi, close valve, and sustain the pressure for a minimum of five (5) minutes.
4. Maximum allowable pressure loss after five (5) minutes is as follows:

<u>Geomembrane Sheet Thickness</u>	<u>Maximum Pressure Loss</u>
40 mils	4 psi

5. If the maximum allowable pressure loss specified above is exceeded or the pressure does not stabilize, locate faulty area and vacuum test in accordance with Article 4.04.C of this Section. If vacuum test fails, repair in accordance with Articles 3.04.Q and 4.06 of this Section, and retest until all leaks are satisfactorily repaired as indicated by passing non-destructive testing.
6. Cut opposite end of tested seam once testing is completed to verify continuity of the air channel. An audible rush of air shall serve as an indicator that the test represents the entire length of seam. If air does not escape, locate blockage and retest unpressurized area. Repair the cut end of the air channel with an extrusion bead or patch as required and perform non-destructive testing in accordance with Article 4.04.C of this Section.
7. Remove needle or other approved pressure feed device and seal penetration holes by extrusion welding and perform non-destructive testing in accordance with Article 4.04.C of this Section.

4.05 DESTRUCTIVE SEAM TESTING

- A. Destructive testing of geomembrane seams (both fusion and extrusion) shall be conducted to verify that seam strength requirements listed in Articles 2.03.C and 2.03.D of this Section have been satisfied for smooth and textured VFPE geomembrane, respectively. Destructive seam testing shall be performed as the work progresses, not at the end of geomembrane installation.
- B. Destructive seam tests shall be conducted at a minimum frequency of one test every five-hundred (500) linear feet of field seam. These frequency requirements shall be considered an average for the entire installation. Individual samples may be obtained at a greater or lesser frequency as determined by the QAO.
- C. Test sample locations shall be selected by the QAO and the sample shall be cut-out by the CONTRACTOR/INSTALLER. At the QAO's discretion, samples may be taken at the end of seams in the anchor trench or at the toe of slope beyond the area of final geomembrane cap to minimize the amount of seam repair necessary.

However, special consideration may be given to locations where the potential for defective seaming exists due to overheating, weld contamination, improper overlap, or adverse weather conditions. The CONTRACTOR/INSTALLER shall not be informed of the locations of destructive seam test samples in advance of seaming.

- D. The QAO may increase the frequency of destructive seam testing under the following circumstances:
1. A high incidence of previous failures (greater than 10 percent).
 2. The seaming device is suspect.
 3. Seaming was performed under adverse weather conditions.
 4. The seam area contained excessive wrinkles.
 5. The seam area was not cleaned properly or dust was present at the time of seaming.
- E. The QAO shall assign a unique number to each destructive seam test and shall observe the cut-out of each sample by the CONTRACTOR/INSTALLER. The locations of all destructive seam test samples shall be recorded on the final record panel layout drawings. The QAO shall record the reason for taking each sample at the particular location (i.e. statistical routine, suspicious seam area, etc.).
- F. The CONTRACTOR/INSTALLER shall repair and non-destructively test all destructive seam test sample locations in accordance with Sections 4.04 and 4.06 of this Section. Repair of these sample locations shall be considered part of the installation and shall be performed at no additional cost to the GROUP.
- G. Field Testing

At each destructive seam test sample location, field and laboratory samples shall be obtained by the CONTRACTOR/INSTALLER. Field samples shall be obtained and tested as follows:

1. Two specimens shall be cut from the field seam at the location indicated by the QAO using a 1-inch-wide die cutter, with the seam centered parallel to the specimen width. The distance between these two specimens shall be forty-two (42) inches measured along the seam.
2. Both specimens shall be tested for peel adhesion (peel) in accordance with ASTM D6392. For double fusion seams, both tracks of the seam shall be tested. Testing shall be conducted in the field by the CONTRACTOR/ INSTALLER using a calibrated tensiometer and observed and documented by the QAO. Testing shall be performed at a constant jaw separation rate of twenty (20) inches per minute.
3. Pass criteria are specified in Article 2.03.C of this Section for smooth VFPE geomembrane and in Article 2.03.D of this Section for textured VFPE geomembrane.
4. If both specimens pass, a full laboratory destructive seam test sample shall be cut out and tested as specified in Article 4.05.H of this Section.

5. If one or both of these specimens fail, the entire destructive seam test sample shall be considered a failure and the seam segment(s) associated with this failure shall be tracked and repaired in accordance with Article 4.05.I of this Section.

H. Laboratory Testing

Destructive seam test samples which pass field testing as outlined in Article 4.05.G of this Section shall be tested at a laboratory approved by the GROUP and the QAO. Laboratory samples shall be obtained and tested as follows:

1. The samples shall be twelve (12) inches wide by forty-two (42) inches long with the seam centered lengthwise and shall be located between the two field specimens obtained in accordance with Article 4.05.G of this Section. The sample shall be cut out by the CONTRACTOR/INSTALLER under the observation of the QAO. The sample shall be cut into three parts and distributed as follows:
 - One 12-inch-wide by 18-inch-long portion to the QAO for laboratory testing.
 - One 12-inch-wide by 12-inch-long portion to the CONTRACTOR/INSTALLER for optional laboratory testing.
 - One 12-inch-wide by 12-inch-long portion to the GROUP for archive storage.
2. The laboratory sample shall be shipped by the QAO to the approved laboratory as soon as possible after cut-out by the CONTRACTOR / INSTALLER.
3. The laboratory shall be cut into ten (10) specimens using a 1-inch-wide die cutter with the seam centered widthwise. Five (5) specimens shall be tested for bonded seam strength (shear) and five (5) for peel adhesion (peel) in accordance with ASTM 6392. Specimens shall be selected alternately by type (peel, shear, peel, shear, etc.). For peel testing of double fusion seams, both tracks of the seam shall be tested. Testing shall be performed at a constant jaw separation rate of twenty (20) inches per minute.
4. Pass criteria are specified in Articles 2.03.B.1 of this Section for smooth VFPE geomembrane and in Articles 2.03.B.2 of this Section for textured VFPE geomembrane.
5. The entire laboratory sample shall be considered passing if at least four (4) out of five (5) specimens in both peel and shear meet the applicable pass criteria.

6. If the laboratory sample fails, the seam segment(s) associated with this failure shall be tracked and repaired in accordance with Article 4.05.I of this Section.
7. The results of testing will be provided to the QAO within twenty-four (24) hours of receipt of the sample by the laboratory.

I. Tracking and Repair of Failed Destructive Test Samples

When a sample fails a destructive test, whether a field or laboratory test, the CONTRACTOR/INSTALLER shall follow the procedure outlined below:

1. The CONTRACTOR/INSTALLER can repair the seam segment(s) between any two passing destructive test locations.
2. Alternatively, the CONTRACTOR/INSTALLER can trace the seaming path to an intermediate location ten (10) feet (minimum) from the location of the original failed test in each direction and cut out a specimen with a 1-inch-wide die cutter for an additional field test at each intermediate location. Each sample shall be tested in peel as in Article 4.05.G of this Section. If these additional specimens pass field testing, then a laboratory sample shall be obtained at each location and tested in accordance with Article 4.05.H. If these samples pass, then the seam segment(s) between these laboratory samples shall be repaired in accordance with Article 4.06 of this Section. If either sample fails, then the procedure is repeated until the limit of the failed seam segment(s) is(are) bound by passing tests in both directions.
3. All acceptable repaired seams must be bound by two (2) locations from which passing laboratory destructive seam test samples have been obtained. Repairs between passing tests shall be made in accordance with Article 4.06 of this Section.
4. At the discretion of the QAO, a laboratory destructive test of a trial seam test sample obtained in accordance with Article 4.03 of this Section may be performed in an attempt to bound a failed destructive test. This may be done in cases of extrusion welding of a series of small repairs; if ambient conditions have changed significantly and/or the seaming device has been adjusted and corrected, or the seamer (operator) has changed since seaming of the failed seam segment(s); or if the seaming device has not been used for a significant period of time (more than 24 hours). If a laboratory test of a trial seam sample passes, this test may be used to bound the failed seam. In such a case, the entire seam length welded by the seaming device in question from the last passing destructive test up to the trial seam test on which the passing laboratory destructive test result was obtained shall be repaired in accordance with Article 4.06 of this Section.

4.06 DEFECTS AND REPAIRS

- A. All seam and non-seam areas of the geomembrane shall be examined by the CONTRACTOR/INSTALLER and the QAO for identification of defects, holes, blisters, undispersed raw materials, large wrinkles, and any sign of contamination by foreign matter. The geomembrane surface shall be cleaned by the CONTRACTOR/INSTALLER prior to this examination if the QAO determines that the amount of dust and mud inhibits proper examination.
- B. Defects identified shall be marked, repaired, and non-destructively tested in accordance with this Section. Repair procedures include the following:
 - 1. Patching, used to repair holes, tears, undispersed raw materials, and contamination by foreign matter.
 - 2. Spot welding used to repair pinholes and other small, localized flaws.
 - 3. Capping, used to repair large lengths of failed seams.
 - 4. Extrusion welding the flap, used to repair areas of inadequate fusion seams which have an exposed edge. Repairs of this type shall be approved in advance by the QAO and shall not exceed one-hundred (100) feet in length unless otherwise approved by the QAO.
 - 5. Removing the defective seam, sliding the panels together to provide the required overlap, and reconstructing the seam.
 - 6. Removing the defective seam and replacing with a strip of new material welded into place.
- C. For any repair method, the following provisions shall be satisfied:
 - 1. Surfaces of the geomembrane which are to be repaired by extrusion welding shall be prepared in accordance with the requirements of Article 3.04.O of this Section.
 - 2. All surfaces shall be clean and dry at the time of the repair.
 - 3. All seaming equipment used to make the repairs shall meet the requirements of this Section.
 - 4. Patches or caps shall extend at least six (6) inches beyond the edge of the defect, and all corners shall be rounded with a radius of approximately three (3) inches. Hook blades shall be used for cutting patches to the maximum extent possible to avoid inadvertently cutting the underlying geomembrane.
- D. All repairs shall be non-destructively tested in accordance with applicable requirements of Article 4.04 of this Section. Repairs which fail non-destructive testing shall be repaired and subsequently retested until project specifications are satisfied.
- E. When seaming of the geomembrane is completed and prior to placement of overlying materials, the QAO and CONTRACTOR/INSTALLER shall examine the geomembrane for wrinkles and areas of “bridging” or “trampolining” (i.e.

where the geomembrane is not in direct contact with the subgrade such as at the toe of slope or other abrupt change in grade). The QAO shall indicate if such areas require repair. Areas of repair shall be kept to an absolute minimum. A wrinkle is considered unacceptable when it can be folded over onto itself. Bridging is considered unacceptable if more than a 12-inch width of the geomembrane is not in contact with the subgrade. The CONTRACTOR/INSTALLER may elect to allow the geomembrane to contract (for wrinkles) or expand (for bridging) prior to placement of overlying materials. Otherwise, unacceptable wrinkles or areas of bridging shall be repaired and tested in accordance with the requirements of this Section. In no case shall overlying components be placed over unacceptable wrinkles or areas of bridging which could result in overstressing of the geomembrane as determined by the QAO.

F. Repairs shall be documented by the CONTRACTOR/INSTALLER as follows:

1. Number and log each repair.
2. Perform appropriate non-destructive testing and provide results to the QAO on a daily basis. The documentation shall identify seams or repairs that initially failed testing criteria and include evidence that these seams or repairs have been repaired and retested successfully.
3. All repairs and associated test results shall be logged and submitted to the GROUP following completion of the work.

4.07 FIELD DOCUMENTATION

- A. The CONTRACTOR/INSTALLER shall maintain a log of all quality control testing performed during installation. This log shall be submitted to the GROUP at the completion of the project.
- B. The CONTRACTOR/INSTALLER shall prepare a record panel drawing locating and identifying geomembrane panels and seams as they have been installed. The drawing shall also indicate the locations of all patches and repairs, and destructive seam test samples. This drawing shall be submitted to the QAO at the completion of the project.

4.08 GEOMEMBRANE PROTECTION

- A. The completed geomembrane shall be adequately protected by the CONTRACTOR/INSTALLER until the installation is accepted by the QAO and the GROUP's REPRESENTATIVE.
- B. No vehicles shall be permitted on exposed geomembrane or geocomposite prior to placement of a minimum 12-inch-thick lift of cover soil. A minimum 12-inch-thick layer shall be maintained between the geomembrane/geocomposite and low ground pressure equipment (less than or equal to 5 psi). Heavy equipment and trucks shall be prohibited from traveling on the cover soil layer except on temporary roadways which are constructed to the minimum thickness as listed below based on the ground pressure of the equipment or vehicles:

Maximum Allowable Equipment Ground Pressure (pounds per square inch (psi))	Minimum Thickness of Overlying Material (inches)
<5	12
5-10	18
10-20	24
>20	36

4.09 GEOMEMBRANE ACCEPTANCE

- A. No geomembrane shall be covered by CONTRACTOR until such time as the QAO has reviewed the test results required by these Specifications. As a minimum, the required quality control and conformance testing, the daily log of trial seam test results, non-destructive seam test results, laboratory destructive seam test results, and record drawings of the completed installation will be reviewed.
- B. A final examination of the geomembrane surface shall be performed by the QAO to verify that all seams have been completed and all defects have been repaired. CONTRACTOR/INSTALLER shall clean the geomembrane surface, as required, to allow for proper examination.
- C. CONTRACTOR shall be held responsible for protection of the installed geomembrane until the geomembrane installation is accepted by the QAO and the GROUP and the overlying components are placed.
- D. The geomembrane shall be considered acceptable after:
 - 1. All required non-destructive seam testing has been performed and has passed the criteria listed in Article 4.04 of this Section.
 - 2. All required destructive seam testing has been performed and has passed the criteria listed in Article 4.05 of this Section.
 - 3. All defects have been repaired and tested in accordance with Article 4.06 of this Section.
 - 4. All submittals required by Article 1.04 of this Section have been received and accepted by the GROUP.
 - 5. Record drawings have been submitted to the GROUP.
 - 6. The construction area has been cleaned and all waste has been removed and disposed of properly.
 - 7. The final examination of the geomembrane has been made and all required documentation has been reviewed and accepted by the QAO.
 - 8. The required material and workmanship warranties have been submitted to and accepted by the GROUP.

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4.10 WARRANTIES

- A. The manufacturer shall warranty that all geomembrane materials are free from manufacturing defects in material and workmanship for a period of five (5) years following shipment to the Site.
- B. CONTRACTOR/INSTALLER shall warranty all work, including the material and all workmanship, for a period of two years following final acceptance by the GROUP.

*****END OF SECTION*****

SECTION 02595

GEOTEXTILES

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall furnish all labor, materials, equipment, tools and appurtenances required to install geotextile(s) to line new access road subgrades, line channels/swales, line outlet aprons, and as otherwise shown on the Contract Drawings.
- B. The CONTRACTOR shall have overall responsibility for the installation of the geotextile(s). The CONTRACTOR shall provide Shop Drawings and a written description detailing the proposed methods to be employed for performing the Work. All materials, equipment and supplies to be incorporated in the Work shall be described, including seaming/overlapping plans, installation procedures, quality control programs, and any other information needed to show the proposed method of conforming to the Contract Documents.

1.02 RELATED SECTIONS

- A. Section 02223 – Backfill and Fill
- B. Section 02233 – Aggregate Materials
- C. Section 02374 – Stone Riprap

1.03 SUBMITTALS

- A. Submit to the QUALITY ASSURANCE OFFICER (QAO) for favorable review at least twenty-one (21) calendar days prior to use the following:
 - 1. Manufacturer's product specifications and written certification from the manufacturer of the geotextile(s) attesting that the geotextile(s) meets the manufacturing requirements specified.
 - 2. Shop Drawings showing proposed installation methods including overlapping, seaming, and layout details.
 - 3. Manufacturer's quality control certificates for each geotextile roll to be delivered to the Site, and all other quality control documentation required by Article 2.04 of this Section.
- B. Submit in accordance with Section 01300 of these Technical Specifications.

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1.04 MATERIAL TRANSPORT

- A. The CONTRACTOR/INSTALLER shall be responsible for the protection of the geotextile rolls against damage during transportation to the Site, during storage at the Site, and prior to placement of subsequent or adjacent construction materials.
- B. Only undamaged geotextile shall be included within the construction. Any damaged material, as determined by the QAO, shall be replaced by the CONTRACTOR/ INSTALLER at no additional cost to the GROUP.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Conform to the manufacturer's requirements to prevent damage to geotextile during delivery, storage, and handling.
- B. Delivery
 - 1. Deliver materials to the Site only after the QAO approves required submittals.
 - 2. Separate any damaged rolls from undamaged rolls and store at locations designated by the QAO until damaged rolls are removed from Site.
 - 3. The QAO shall be the final authority regarding damage.
 - 4. Separate rolls without proper documentation and store until QAO approval is received.
- C. On-Site Storage
 - 1. Store all materials in an area designated by the QAO.
 - 2. The CONTRACTOR shall, during all periods of shipment and storage, protect the geotextile from direct sunlight, ultraviolet light, temperatures greater than 120°F, mud, dirt, dust, debris and other possible sources of damage. Geotextile rolls shall be wrapped in a heavy-duty protective covering until needed for installation.
 - 3. Store on a level prepared surface (not on wooden pallets).
 - 4. Stack rolls in accordance with the manufacturer's recommendation but no more than five rolls high.
- D. On-Site Handling
 - 1. CONTRACTOR/INSTALLER shall use appropriate handling equipment to load, move and deploy geotextile rolls. Appropriate handling equipment includes cloth chokers and spreader bar for loading, and spreader and roll bars for deployment. Dragging or rolling panels on the ground surface shall not be permitted.

2. The CONTRACTOR/INSTALLER shall be responsible for off-loading, storage, and transporting material from the storage area to the area of installation.
- E. The CONTRACTOR shall protect the work described in this Section before, during, and after installation, and shall protect the installed work from damage from Work covered by other Sections of these Specifications.
- F. If the QAO determines that the geotextile material is damaged, or has experienced excessive exposure to sunlight (more than the manufacturer's recommendations, but in no case over 30 days), the CONTRACTOR shall immediately make all repairs and replacements, at the CONTRACTOR's sole expense.

PART 2 - MATERIALS

2.01 10 OZ./ S.Y. NONWOVEN GEOTEXTILE

- A. The nonwoven geotextile to be used for channels, swales, apron, and toe drain lining, or as otherwise shown on the Contract Drawings, shall consist of needle-punched, continuous filament polyester or polypropylene fabric, and conform to the following minimum requirements:

Property	Requirements*	Test Method
Mass/Area	10 oz/sy	ASTM D5261
Trapezoidal Tear Strength	90 lbs	ASTM D4533
Grab Tensile Strength	230 lbs	ASTM D4632
Grab Tensile Elongation	50%	ASTM D4632
Burst Strength	500 lb/in ²	ASTM D3786
Puncture Strength	130 lbs	ASTM D4833
Apparent Opening Size**	70-120 Sieve	ASTM D4751

*All values are minimum.

**For filter applications only.

2.02 WOVEN GEOTEXTILE

- A. The woven geotextile to be used under road base, or as otherwise shown on the Contract Drawings, shall be manufactured by Amoco, T.C. Mirafi, Synthetic Industries, or other manufacturer favorably reviewed by the REMEDIAL DESIGNER. Woven geotextiles shall conform to the following minimum requirements:

Property	Requirements*	Test Method
Grab Tensile Strength	250 lbs	ASTM D4632
Grab Tensile Elongation	12%	ASTM D4632

Property	Requirements*	Test Method
Burst Strength	500 lb/in ²	ASTM D3786
Puncture Strength	115 lbs	ASTM D4833

2.03 GEOTEXTILE ROLLS

- A. All geotextiles shall be provided in rolls not less than fifteen (15) feet in width.
- B. Each roll shall be identified by a number and date of manufacture. Labels or markers used for identification shall be of a type which will not degrade the liner material. The labels shall contain, at a minimum, the following information:
 - 1. Manufacturer's name.
 - 2. Product identification.
 - 3. Nominal thickness.
 - 4. Roll Number.
 - 5. Lot/Batch Number.
 - 6. Roll Dimensions.

2.04 QUALITY CONTROL DOCUMENTATION

- A. Prior to installation of any geotextile, the manufacturer or CONTRACTOR shall provide the QAO with the following documentation:
 - 1. The origin (supplier's name and production plant), identification (brand name and number), and production date of resin used to manufacture the geotextile.
 - 2. Copies of dated quality control certificates issued by the resin supplier.
 - 3. Specifications for the geotextile which includes all properties listed in Articles 2.01 or 2.02 of this Section, as applicable, measured using the specified test methods.
 - 4. Written certification that the minimum values given in the specification are guaranteed by the manufacturer.
 - 5. Quality control certificates, signed by a responsible party employed by the manufacturer, indicating product designation, roll number identification, date of manufacturer, resin batch identification, testing procedures, and the results of all quality control tests. At a minimum, the tests listed in Articles 2.01 and 2.02 shall be performed, as applicable.
- B. Geotextiles shall be tested and receive favorable review of test results by the QAO prior to shipment to ensure that the properties of the finished product are in accordance with the Specifications. Samples of geotextile materials shall be tested by the manufacturer at the CONTRACTOR's expense. Samples will be tested by the manufacturer at a frequency of one (1) sample for every 90,000 ft² of material produced for each lot and material type. The required material

properties, test methods, values, and units are presented in Articles 2.01 and 2.02, as applicable, of this Section.

- C. In addition, one (1) sample 3-foot-wide by the width of the roll, from each roll tested, will be retained by the manufacturer or CONTRACTOR for possible further testing until construction for which the geotextile is used is complete and favorably reviewed by the QAO. Each sample of geotextile will have the roll number, lot number, date of manufacture, machine direction, and manufacturer name clearly marked on or attached to the sample.
- D. All quality control test results shall be reviewed by the QAO for conformance with the minimum properties listed in Articles 2.01 and 2.02 of this Section, as applicable. Any nonconformance shall be reported to the GROUP's REPRESENTATIVE and shall be the basis of rejection of the nonconforming rolls.
- E. The CONTRACTOR shall be solely responsible for the quality of the material provided. Should any of the tests performed on the material yield unsatisfactory results, the CONTRACTOR will be responsible for replacing the material with satisfactory materials without delay to the Work and at CONTRACTOR's sole expense.
- F. Quality control during construction shall be performed by the CONTRACTOR in accordance with Article 3.04 of this Section.

2.05 CONFORMANCE TESTING

- A. Upon delivery of the material to the Site, the QAO shall obtain conformance test samples from selected geotextile rolls at a minimum frequency of one sample per 100,000 ft², or one per lot, whichever results in a higher frequency, to verify conformance with the project specifications. Alternatively, samples may be obtained at the manufacturing facility prior to material delivery to the Site, if desired by the GROUP's REPRESENTATIVE.
- B. Samples shall be three (3) feet by the entire width of the roll and shall be obtained after the first three (3) feet (or more if material is damaged as determined by the QAO) of the roll has been removed. Samples shall be marked with "machine direction" indicated prior to shipment to the laboratory.
- C. Conformance testing shall be performed by a qualified geosynthetic materials testing laboratory approved by the GROUP's REPRESENTATIVE and the QAO.
- D. The following conformance tests shall be performed for geotextile:
 - 1. Mass/Area* ASTM D5261
 - 2. Grab Tensile Strength and Elongation ASTM D4632

3.	Puncture Strength	ASTM D4833
4.	Burst Strength	ASTM D3786
5.	Trapezoidal Tear Strength	ASTM D4533
6.	Apparent Opening Size*	ASTM D4751

*Nonwoven geotextile only

- E. All conformance test results shall be reviewed by the QAO for conformance with the minimum physical properties listed in Articles 2.01 and 2.02 of this Section, as applicable. Any nonconformance shall be reported to the GROUP's REPRESENTATIVE and shall be the basis of rejection of the nonconforming rolls.
- F. If a test result does not meet the project specifications, all material from the resin lot or batch represented by the failing sample shall be considered out-of-specification and rejected. Alternatively, at the option of the QAO, additional conformance test samples may be taken to bracket the portion of the batch not meeting the specification. This procedure is valid only when all rolls in the batch are consecutively produced and numbered from one manufacturing line. To isolate out-of-specification material, additional samples shall be taken from rolls which have numbers immediately adjacent (or the next roll number present on-Site from the same batch) to the roll that was initially sampled and failed. If both additional tests pass, the roll that represents the initial failed test and the roll manufactured immediately after that roll (next larger roll number), if present on-Site, shall be rejected. If one or both of the additional tests fail, then the entire batch shall be rejected or this procedure repeated with two additional tests that bracket a greater number of rolls within the batch. All additional testing shall be at the cost to the manufacturer.

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

- A. Any subbase or subgrade surfaces to receive a geotextile shall be cleared of sharp objects, boulders, stumps, debris, or any materials that may contribute to fabric punctures, shearing, rupturing or tearing to the satisfaction of the QAO.
- B. Subbase or subgrade surfaces underlying areas planned to receive a nonwoven geotextile or woven geotextile shall be graded smooth and then compacted.
- C. Trench or channel excavations planned to receive geotextiles shall be visually observed and favorably reviewed by the QAO.

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3.02 INSTALLATION

- A. The geotextile shall be placed in the manner and at the locations shown on the contract drawings. Geotextile shall be laid smooth and free of tension, stress, folds, wrinkles, or creases.
- B. Geotextile seams shall be overlapped a minimum of six (6) inches prior to seaming. All geotextile seams shall be joined by continuous sewing. Sewing will be performed using polymeric thread with chemical resistance properties equal to or exceeding those of the geotextile. The manufacturer shall certify, in writing, that the thread meets this requirement. Thread color shall contrast that of the geotextile.
- C. Overlying materials shall be placed or spread in a manner such that wrinkles, excessive tension, or other damage does not occur. Gravel surface courses and stone riprap shall not be dropped from a height exceeding three (3) feet.
- D. If nonwoven geotextile is damaged during any step of installation or placement of overlying materials, a piece of geotextile material shall be cut and placed over the damaged area and overlapped a minimum of 3 feet in each direction, and leistered around the edges, over undamaged material. For woven geotextile, the overlap shall be six (6) inches in each direction and sewn as indicated in Article 3.02.B.

3.03 PROTECTION

- A. After installation, visually inspect the geotextile to assure that no objects are present that could potentially harm the geotextile.
- B. Any geotextile damaged during installation or during placement of overlying material shall be replaced by the CONTRACTOR at the CONTRACTOR's sole expense.
- C. The Work shall be scheduled so that, in general, the covering of the geotextile is accomplished within the maximum exposure time recommended by the manufacturer, but in no case longer than 30 calendar days after placement of the geotextile. Failure to comply with this requirement shall require replacement of the geotextile at the CONTRACTOR's sole expense.
- D. No equipment shall be operated directly on the geotextiles prior to the placement of overlying materials. Provide a minimum twelve (12) inches of separation between any geotextile and low ground pressure equipment (5 psi) or three (3) feet of separation when using equipment greater than five (5) psi.

3.04 QUALITY ASSURANCE/QUALITY CONTROL

A. GENERAL

1. The CONTRACTOR, before installation begins, shall appoint an experienced superintendent thoroughly experienced with work similar to the requirements specified herein, and who will be on-Site at all times during the geotextile installation, to represent the CONTRACTOR in all matters relevant to this Work. This appointment shall be subject to favorable review by the QAO.
2. Any changes in the proposed method of work, subcontractors to be utilized, or manufacturing must be favorably reviewed in advance by the QAO. The CONTRACTOR assumes all responsibility relevant to providing an acceptable product and installation.

B. QUALITY CONTROL DURING INSTALLATION

1. The CONTRACTOR shall visually inspect all material to be included in the Work for transport damage and uniformity and compare roll identification numbers with those on the certification provided by the manufacturer to assure delivery of the appropriate material.
2. The Installer and CONTRACTOR shall also visually inspect the material for any damage incurred as a result of handling or on-Site storage.
3. After the CONTRACTOR has completed each area of work and thoroughly inspected all installation and seaming, the QAO will visually inspect all seams for continuity and quality. Do not cover any geotextile prior to receiving favorable review from the QAO. All inadequate seams shall be repaired at the CONTRACTOR's sole expense.

*****END OF SECTION*****

SECTION 02598

GEOSYNTHETIC CLAY LINER

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall furnish all materials, labor, equipment, tools and appurtenances required to install the geosynthetic clay liner (GCL) for the cap as shown on the Contract Drawings.
- B. Installation of the GCL shall be completed by an experienced specialty SUBCONTRACTOR (Installer) fully qualified to complete the portions of the Work as specified in this Section. Reference to CONTRACTOR implies Installer as appropriate in this Section.
- C. The CONTRACTOR shall have overall responsibility for the installation of the GCL. The CONTRACTOR, as assisted by the Installer, shall provide Shop Drawings and a written description detailing the proposed methods to be employed for performing the Work. All materials, equipment, and supplies to be incorporated into the Work shall be described, including seaming plans, installation procedures, quality control programs, and any other information needed to show the proposed method of conforming to the Contract Documents.
- D. A pre-installation meeting shall be held between the CONTRACTOR, Installer, GROUP's REPRESENTATIVE, and the QUALITY ASSURANCE OFFICER (QAO) at least two (2) workdays prior to beginning the deployment of the GCL.
- E. The GCL shall be installed with great care in a manner that will not cause damage to the material. Deployment of all overlying materials shall be performed without damage to the GCL. At no time shall vehicles or construction equipment drive directly on the GCL.

1.02 RELATED SECTIONS

- A. 02223 – Backfill and Fill
- B. 02590 – Geomembranes

1.03 SUBMITTALS

- A. Submit the QAO for favorable review not less than twenty-one (21) calendar days prior to use the following information regarding the geosynthetic clay liner proposed for use.

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1. Manufacturer and product name;
 2. Evidence that the Manufacturer has more than five years of experience in the manufacturing of geosynthetic clay liner;
 3. Manufacturer's quality control procedures;
 4. Manufacturer's requirements for any geotextile component of the GCL to include a minimum, mass per unit area, grab strength, and grab elongation are to be required;
 5. Certification that manufacturer's requirements for geotextile component of GCL are met;
 6. Certification of minimum average roll values (95% lower confidence limit) and the corresponding test procedures for all geosynthetic clay liner properties listed in Article 2.01.C; and
 7. Manufacturer's recommended procedures for overlapping adjacent geosynthetic clay liner panels.
- B. Submit to the QAO for review at least twenty-one (21) calendar days prior to geosynthetic clay liner placement, manufacturing quality control certificates for each roll of geosynthetic clay liner as specified in this Section. Submit certificates signed by the Manufacturer quality control manager, and notarized. The quality control certificates shall include:
1. Lot, batch, or roll numbers and identification;
 2. Sampling procedures; and
 3. Results of manufacturer quality control tests as described in Article 2.03 of this Section.
 4. Resumes of the Installer's supervisor and crew. The Installer shall have extensive, previous experience in the installation of GCL materials. The supervisor will be required to provide satisfactory evidence demonstrating the successful completion of a minimum of 100 acres of GCL under the proposed supervisor's previous supervision. The GCL installation crew will be subject to favorable review by the QAO.
 5. Written certification that all lots of the product to be delivered have been manufactured with high-quality sodium bentonite. This certification shall include the origin (supplier's name and processing plant), identification (brand name and number), and quality control certificates issued by the supplier. No material will be permitted to be stored on Site until this certification has been favorably reviewed by the QAO.
- C. Submit in accordance with Section 01300 of these Technical Specifications.

1.04 MATERIAL TRANSPORT

- A. The CONTRACTOR/INSTALLER shall be responsible for the protection of the GCL rolls against damage during transportation to the Site, during storage at the Site, and prior to placement of subsequent or adjacent construction materials.

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- B. Only undamaged GCL shall be included within the construction. Any damaged material, as determined by the QAO, shall be replaced by the CONTRACTOR/INSTALLER at no additional cost to the GROUP.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Conform to the manufacturer's requirements to prevent damage to GCL during delivery, storage, and handling.
- B. Delivery
 - 1. Deliver materials to the Site only after the QAO approves required submittals.
 - 2. Separate any damaged rolls from undamaged rolls and store at locations designated by the QAO until damaged rolls are removed from Site.
 - 3. The QAO shall be the final authority regarding damage.
 - 4. Separate rolls without proper documentation and store until QAO approval is received.
- C. On-Site Storage
 - 1. Store all materials in an area designated by the QAO.
 - 2. Protect from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, and other potential damage.
 - 3. Store on a level prepared surface (not on wooden pallets).
 - 4. Stack rolls in accordance with the manufacturer's recommendation but no more than five rolls high.
- D. On-Site Handling
 - 1. CONTRACTOR/INSTALLER shall use appropriate handling equipment to load, move and deploy GCL rolls. Appropriate handling equipment includes cloth chokers and spreader bar for loading, and spreader and roll bars for deployment. Dragging or rolling panels on the ground surface shall not be permitted.
 - 2. The CONTRACTOR/INSTALLER shall be responsible for off-loading, storage, and transporting material from the storage area to the area of installation.
- E. The CONTRACTOR shall protect the work described in this Section before, during, and after installation, and shall protect the installed work from damage from Work covered by other Sections of these Specifications.
- F. If the QAO determines that the GCL material is damaged, or has become hydrated, the CONTRACTOR shall immediately make all repairs and replacements, at the CONTRACTOR's sole expense.

PART 2 - PRODUCTS

2.01 GEOSYNTHETIC CLAY LINER

- A. The geosynthetic clay layer (GCL) shall consist of a layer of pure powdered sodium bentonite clay encased between two nonwoven geotextiles. The GCL shall have been manufactured by mechanically bonding the geotextiles using a continuous needle-punching process to push the geotextile fibers from one geotextile through the bentonite clay layer and into the opposing geotextile forming an interlocked bond. The finished GCL product shall be subjected to a magnetic field to locate and remove broken needles which may have become lodged within the material during needle-punching.
- B. The CONTRACTOR shall not order, obtain or install any GCL material which has not been tested, met the specified criteria, and been favorably reviewed by the QAO.
- C. The delivered GCL rolls for construction of the cover system shall conform to the following minimum properties:

<u>Property</u>	<u>Test Method</u>	<u>Value</u> ¹	<u>Units</u>
1. Thickness (dry)	ASTM D1777	0.20	Inch
2. Bentonite Content (at 0 percent moisture)	ASTM D5993	0.75	lbs./in ²
3. Grab Tensile Strength	ASTM D4632	88	lbs.
4. Peel Strength ²	ASTM 6496	25	lbs.
5. Hydraulic Conductivity(max.)	ASTM D5084	5 x 10 ⁻⁹	cm/sec
6. Interface Shear Strength ³	ASTM D5321	25.3	Degrees
7. Internal Shear Strength ⁴	ASTM D6243	500	lbs/ft ²

¹Minimum value unless specified otherwise.

²Based on 4-inch wide specimen and 4-inch wide grip. Alternatively, a value of fifteen (15) lbs. is acceptable based on a 4-inch wide sample and 1-inch wide grip.

³Minimum interface friction angle between the GCL (heat calendared side) and 40-mil textured geomembrane. Confining pressures at 100, 250, and 500 psf. with saturated interface. GCL shall be saturated and consolidated for a minimum of 24 hours before shearing.

⁴Peak value measured at two-hundred (200) psf (30 kPa) normal stress. One test per manufactured lot.

2.02 GCL ROLLS

- A. GCL rolls shall be at least fourteen (14) feet in width and a minimum of one-hundred-fifty (150) feet in length. The CONTRACTOR shall be capable of providing rolls of up to two-hundred (200) feet in length, if required, to reduce GCL cross seams on slopes greater than ten (10) percent.

- B. Each roll shall be identified by a number and date of manufacture. Labels or markers used for identification shall be of a type which will not degrade the liner material. The labels shall contain, at a minimum, the following information:
1. Manufacturer's name.
 2. Product identification.
 3. Nominal thickness.
 4. Roll Number.
 5. Lot/Batch Number.
 6. Roll Dimensions.

2.03 QUALITY CONTROL (QC) TESTING OF GCL

- A. Prior to installation of any GCL, the manufacturer or CONTRACTOR shall provide the QAO with the following documentation:
1. The origin (supplier's name and production plant), identification (brand name and number), and production date of the GCL.
 2. Copies of dated quality control certificates issued by the bentonite and geotextile suppliers.
 3. Specifications for the GCL which includes all properties listed in Article 2.01 of this Section measured using the specified test methods.
 4. Written certification that the minimum values given in the specification are guaranteed by the manufacturer.
 5. Quality control certificates, signed by a responsible party employed by the manufacturer, indicating product designation, roll number identification, date of manufacturer, lot or batch identification, testing procedures, and the results of all quality control tests. At a minimum, the tests listed in Article 2.01 shall be performed.
- B. GCL shall be tested and receive favorable review of test results by the QAO prior to shipment to ensure that the properties of the finished product are in accordance with the Specifications. Samples shall be tested by the GCL manufacturer at the CONTRACTOR's expense. Samples will be tested by the manufacturer at a frequency of at least one (1) sample for every 50,000 square feet of material produced for supply to the Work, and at least one (1) per lot to demonstrate compliance with all tests, properties, and requirements of Article 2.01 herein. Coefficient of interface friction and internal hydrated shear strength shall be tested at a frequency of one test per product of GCL manufactured.
- C. In addition, one (1) sample 3-foot-wide by the width of the roll, from each roll tested, will be retained by the manufacturer or CONTRACTOR for possible further testing until construction for which the GCL is used is complete and favorably reviewed by the QAO. Each sample of GCL will have the roll

number, lot number, date of manufacture, machine direction, and manufacturer name clearly marked on or attached to the sample.

- D. All quality control test results shall be reviewed by the QAO for conformance with the minimum properties listed in Article 2.01 of this Section. Any nonconformance shall be reported to the GROUP's REPRESENTATIVE and shall be the basis of rejection of the nonconforming rolls.
- E. The CONTRACTOR shall be solely responsible for the quality of the material provided. Should any of the tests performed on the material yield unsatisfactory results, the CONTRACTOR will be responsible for replacing the material with satisfactory materials without delay to the Work and at CONTRACTOR's sole expense.
- F. Quality control during construction shall be performed by the CONTRACTOR in accordance with Part 4 of this Section.

2.05 CONFORMANCE TESTING

- A. Upon delivery of the material to the Site, the QAO shall obtain conformance test samples from selected GCL rolls at a minimum frequency of one sample per 100,000 ft², or one per lot, whichever results in a higher frequency, to verify conformance with the project specifications. Alternatively, samples may be obtained at the manufacturing facility prior to material delivery to the Site, if desired by the GROUP's REPRESENTATIVE.
- B. Samples shall be three (3) feet by the entire width of the roll and shall be obtained after the first three (3) feet (or more if material is damaged as determined by the QAO) of the roll has been removed. Samples shall be marked with "machine direction" indicated prior to shipment to the laboratory.
- C. Conformance testing shall be performed by a qualified geosynthetic materials testing laboratory approved by the GROUP's REPRESENTATIVE and the QAO.
- D. The following conformance tests shall be performed for geotextile:
 1. Bentonite Content ASTM D5993
 2. Grab Tensile Strength ASTM D4632
 3. Peel Strength ASTM D6496
 4. Hydraulic Conductivity ASTM D5084
- E. All conformance test results shall be reviewed by the QAO for conformance with the minimum physical properties listed in Article 2.01 of this Section. Any nonconformance shall be reported to the GROUP's REPRESENTATIVE and shall be the basis of rejection of the nonconforming rolls.

- F. If a test result does not meet the project specifications, all material from the lot or batch represented by the failing sample shall be considered out-of-specification and rejected. Alternatively, at the option of the QAO, additional conformance test samples may be taken to bracket the portion of the batch not meeting the specification. This procedure is valid only when all rolls in the batch are consecutively produced and numbered from one manufacturing line. To isolate out-of-specification material, additional samples shall be taken from rolls which have numbers immediately adjacent (or the next roll number present on-Site from the same batch) to the roll that was initially sampled and failed. If both additional tests pass, the roll that represents the initial failed test and the roll manufactured immediately after that roll (next larger roll number), if present on-Site, shall be rejected. If one or both of the additional tests fail, then the entire batch shall be rejected or this procedure repeated with two additional tests that bracket a greater number of rolls within the batch. All additional testing shall be at the cost to the manufacturer.

PART 3 - EXECUTION

3.01 SUBGRADE FOR GCL

- A. The surface on which the GCL is to be placed shall consist of a compacted grading fill as specified in Section 02223 of these Specifications.
- B. Prior to placement of the GCL, the subgrade shall be fine-graded, as shown on the Contract Drawings, and compacted to the minimum specified density in accordance with Section 02223 of these Specifications.
- C. Prior to the placement of the GCL, the surface of the grading fill shall be proof-rolled with smooth drummed compaction equipment weighing at least 20 tons, unless otherwise approved by the QAO. This proof rolling shall create a smooth unyielding surface, free from pockets, holes, sharp objects, particles greater than 1-inch in maximum dimension, sudden grade changes or discontinuities which could cause bridging. Compaction equipment shall be favorably reviewed by the QAO prior to use.
- D. The installer shall provide a written certificate of subgrade acceptance for each area on which GCL is to be placed each day.
- E. The QAO will also observe the completed subgrade. Do not proceed with installation of the GCL until the QAO has favorably reviewed the subgrade.
- F. The installer shall not place GCL on subgrade areas that have become altered due to mechanical means, precipitation, and/or desiccation. Damage to the subgrade shall be repaired by the CONTRACTOR prior to GCL installation.

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3.02 FIELD INSTALLATION

- A. The CONTRACTOR shall handle GCL materials/rolls in such a manner as to ensure they are not damaged in any way.
- B. All required cuts in the GCL shall be made using a utility knife with a sharp blade. Blades shall be changed frequently to maintain suitable sharpness for cutting. Care shall be exercised to prevent alteration or damage to any underlying material during cutting. Used blades shall be carefully disposed and not placed on geosynthetic surfaces.
- C. During placement, care shall be taken not to entrap stones, other potentially damaging objects, or moisture under the GCL.
- D. Under no circumstance shall equipment or other potentially damaging objects be dragged across exposed surfaces of the GCL.
- E. Any GCL roll, panel, or portion thereof which is damaged by stones or other objects, or installation activities shall be replaced by the CONTRACTOR at no additional cost to the GROUP.
- F. The CONTRACTOR shall not install GCL material on a saturated subgrade or on standing water. The GCL shall be installed in a way that prevents hydration prior to completion of the capping system.
- G. The GCL shall not be installed during precipitation events or other conditions that may cause hydration of the GCL.
- H. Any and all GCL that becomes hydrated, as determined by the QAO, shall be replaced by the CONTRACTOR at no additional cost to the GROUP.
- I. All GCL that is placed during one day shall be covered by the geomembrane before the CONTRACTOR leaves the Site at the end of that day or before a precipitation event.
- J. The CONTRACTOR shall not place geomembrane over any GCL that is hydrated.
- K. The geomembrane panels placed over a GCL shall be seamed as soon as possible after each panel is placed, but, in any event, before the end of the day on which placed and prior to any precipitation.
- L. Any and all defects, including sample locations, in the geomembrane panels/seams overlying a GCL shall be immediately repaired.

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M. Seams in GCL Panels:

1. Seams shall be in accordance with manufacturer's recommendations. Supplemental bentonite powder may be added to the seams if required by the manufacturer for the product supplied.
2. Horizontal seams shall be minimized on slopes steeper than ten (10) percent. Horizontal seams on slopes greater than ten (10) percent may be installed if the slope length exceeds the original roll length. In such cases, the seams shall be restricted to the bottom third of the slope and seams shall be staggered from one panel to the next, such that they do not line up across the slope. The seams shall be shingled, so that the bottom end of the upper roll is overlying the top of the next adjacent roll down slope.
3. Finished seams, immediately prior to placement of the geomembrane layer, shall have panel overlaps of at least six (6) inches along the sides of adjacent panels and at least one (1) foot at the ends.
4. Edges of GCLs shall be pulled taught to remove any wrinkles or creases in the seam areas.
5. Seams/overlaps shall not be nailed or stapled to the subgrade.

N. Repair:

1. Holes, tears, or mechanically damaged areas in the GCL shall be repaired by closing or removing the damaged portion and placing a GCL patch over the hole. Hydrated areas shall be cut away and removed, then patched. Such patch shall overlap all edges of the damaged area by 1 foot (minimum). Accessory clay material, to be obtained from the GCL manufacturer, shall be placed between the patch and the repaired area of the GCL.
2. Prior to the installation of any patch, the CONTRACTOR shall remove any soil or other material that potentially may adversely affect the bond between the patch and the underlying GCL.
3. All repairs shall be made at no additional cost to the GROUP, and no schedule delays.
4. Patch materials shall not be nailed or stapled to the subgrade.

3.03 COVERING OF GCL

- A. The GCL shall be covered by the geomembrane on the same day it was deployed, and the geomembrane shall be seamed that same day.
- B. At no time shall driving of vehicles or equipment be permitted directly on the GCL during deployment of the overlying geomembrane.

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- C. If, in the opinion of the QAO, the GCL becomes damaged during installation of the overlying geomembrane, the geomembrane shall be removed to allow repair or replacement of the GCL, at no expense to the GROUP.
- D. Following placement of overlying geomembrane, the CONTRACTOR shall use whatever methods deemed necessary to prevent water or wind from getting under partially installed geomembrane. This could include, but is not limited to, the installation of temporary dikes and sand bags along the exposed edges. Should, in the opinion of the QAO, excessive moisture become trapped below the geomembrane, or wind damage be incurred, the CONTRACTOR shall remove and replace the damaged GCL as determined by the QAO, at the CONTRACTOR's expense. If the underlying GCL becomes hydrated as a result of this excessive moisture, it shall also be removed and replaced.
- E. The CONTRACTOR shall place the geocomposite and cover soil above the geomembrane in a timely fashion after installation of the geomembrane. If the GCL become hydrated prior to placement of the cover soil, it shall be replaced at no expense to the GROUP.

PART 4 - QUALITY ASSURANCE/QUALITY CONTROL DURING INSTALLATION

4.01 REQUIREMENTS

- A. Any changes in the proposed method of Work, subcontractors/installers to be utilized, or GCL supplier must be favorably reviewed in advance by the QAO.
- B. The QAO and the CONTRACTOR shall visually inspect all material to be included in the Work for transportation/storage damage and uniformity, and compare roll identification numbers with those on the certification provided by the manufacturer to assure delivery of the appropriate material.
- C. The Installer shall repair all GCL panels and seams that are found to be unacceptable by the QAO. Repairs shall be performed by methods favorably reviewed by the QAO.

4.02 WARRANTIES

- A. The manufacturer shall warranty that all GCL materials are free from manufacturing defects in material and workmanship for a period of five (5) years following shipment to the Site.
- B. The CONTRACTOR/INSTALLER shall warranty all work, including the material and all workmanship, for a period of two years following final acceptance by the GROUP.

*****END OF SECTION*****

SECTION 02599

GEOCOMPOSITE DRAINAGE LAYER

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall furnish all labor, materials, equipment, tools and appurtenances required to install the geocomposite drainage layer as shown on the Contract Drawings.
- B. Installation of the geocomposite shall be completed by an experienced subcontractor (Installer) fully qualified to complete the portions of the Work as specified in this Section. Reference to CONTRACTOR implies Installer as appropriate in this Section.
- C. The CONTRACTOR shall have overall responsibility for installation of the geocomposite. The CONTRACTOR, as assisted by the Installer, shall provide Shop Drawings and a written description detailing the proposed methods to be employed for performing the Work. All materials, equipment and supplies to be incorporated in the Work shall be described, including seaming/overlapping plans, installation procedures, quality control programs, and any other information needed to show the proposed method of conforming to the Contract Documents.
- D. During deployment of geocomposite, no vehicles or construction equipment shall drive directly on the geocomposite or on previously placed geosynthetics, as specified in Article 3.01.D of this Section.

1.02 RELATED SECTIONS

- A. Section 02224 – Cover Soil
- B. Section 02225 – Vegetative Support Layer
- C. Section 02590 – Geomembranes

1.03 SUBMITTALS

- A. Submit to the QUALITY ASSURANCE OFFICER (QAO) for favorable review, at least twenty-one (21) calendar days prior to use, the following:
 - 1. Manufacturer's product specifications and written certification from the manufacturer of the geocomposite attesting that the material components meets the manufacturing requirements specified.

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2. Shop Drawings showing proposed installation methods including overlapping, seaming, and layout details.
3. Manufacturer's quality control certificates for each geocomposite roll to be delivered to the Site, and all other quality control documentation required by Article 2.04 of this Section.

- B. Submit in accordance with Section 01300 of these Technical Specifications.

1.04 MATERIAL TRANSPORT

- A. The CONTRACTOR/INSTALLER shall be responsible for the protection of the geocomposite rolls against damage during transportation to the Site, during storage at the Site, and prior to placement of subsequent or adjacent construction materials.
- B. Only undamaged geocomposite shall be included within the construction. Any damaged material, as determined by the QAO, shall be replaced by the CONTRACTOR/INSTALLER at no additional cost to the GROUP.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Conform to the manufacturer's requirements to prevent damage to geocomposite during delivery, storage, and handling.
- B. Delivery
1. Deliver materials to the Site only after the QAO approves required submittals.
 2. Separate any damaged rolls from undamaged rolls and store at locations designated by the QAO until damaged rolls are removed from Site.
 3. The QAO shall be the final authority regarding damage.
 4. Separate rolls without proper documentation and store until QAO approval is received.
- C. On-Site Storage
1. Store all materials in an area designated by the QAO.
 2. The CONTRACTOR shall, during all periods of shipment and storage, protect the geocomposite from direct sunlight, ultraviolet light, temperatures greater than 120°F, mud, dirt, dust, debris and other possible sources of damage. Geocomposite rolls shall be wrapped in a heavy-duty protective covering until needed for installation.
 3. Store on a level prepared surface (not on wooden pallets).
 4. Stack rolls in accordance with the manufacturer's recommendation but no more than five rolls high.

D. On-Site Handling

1. CONTRACTOR/INSTALLER shall use appropriate handling equipment to load, move and deploy geocomposite rolls. Appropriate handling equipment includes cloth chokers and spreader bar for loading, and spreader and roll bars for deployment. Dragging or rolling panels on the ground surface shall not be permitted.
2. The CONTRACTOR/INSTALLER shall be responsible for off-loading, storage, and transporting material from the storage area to the area of installation.

E. The CONTRACTOR shall protect the work described in this Section before, during, and after installation, and shall protect the installed work from damage from Work covered by other Sections of these Specifications.

F. If the QAO determines that the geocomposite material is damaged, or has experienced excessive exposure to sunlight (more than the manufacturer's recommendations, but in no case over thirty (30) calendar days), the CONTRACTOR shall immediately make all repairs and replacements, at the CONTRACTOR's sole expense.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. The geonet component of the geocomposite shall be manufactured from pure virgin high-density polyethylene (HDPE) resin satisfactory for the intended use, having a minimum density of 0.940 g/cm³ (after carbon black blending). The pure virgin resin shall be mixed with two (2) to three (3) percent carbon black, pre-blended according to specifications of the manufacturer. The geonet component shall be manufactured with solid ribs of polyethylene.
- B. The geotextile portion of the geocomposite shall be a minimum 6.0 oz/sy nonwoven polyester or polypropylene needle-punched geotextile, heat bonded to one or both sides of a geonet, designed and manufactured specifically for the purpose of liquid filtration and conveyance.
- C. Provide the QAO with a written and signed certification from the manufacturers that the geonet portion of the product to be delivered has been extruded from a favorably reviewed HDPE resin satisfactory for the intended use. No material will be permitted to be shipped to Site until this certification has been delivered to the QAO.

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2.02 MANUFACTURING

- A. The manufacturer of the geocomposite shall be subject to favorable review by the QAO and have at least five years of experience in extruding geonet and bonding geotextiles with the geonet. The CONTRACTOR shall submit the manufacturing company, address, and name of contact, with telephone number, to the QAO. The geocomposite shall be formulated from the appropriate polymers and compounding ingredients to form a geocomposite that meets all requirements for the specified end use of the product.
- B. The geocomposite shall have nonwoven geotextiles heat bonded to both the top of bottom of the geocomposite.
- C. The final manufactured geocomposite shall be capable of providing high flow rates (therefore, high transmissivity) under the anticipated soil loads and in compliance with the following specifications:

Property	ASTM Test Method	Specified Value**	Units
1. <u>Flow Capacity</u>			
a. Transmissivity ⁽¹⁾ (Geocomposite)	D4716	8.2. x 10 ⁻⁴	m ² /sec
b. Permittivity (Top Geotextile)	D4491	1.3	gal/min/ft ²
2. <u>Mechanical Properties</u>			
a. Grab Tensile Strength (Top & Bottom Geotextile)	D4632	150	lbs
b. Apparent Opening Size (Top Geotextile)(max in mm)	D4751	0.212 70	mm Sieve
c. Peak Tensile Strength (Geonet)	D5035	40	lb/in. width
d. Ply Adhesion (Geocomposite)	F904 modified or D413	1.0	lb/in.
e. Coefficient of Friction ⁽²⁾	D5321	25.3	degrees
3. <u>Material Properties</u>			
a. Polyethylene Density (Geonet)	D1505	0.940	g/cm ³
b. Carbon Black Content (Geonet)	D1603	2.0-3.0	%
4. <u>Dimensions</u>			
Thickness (Geonet)	D5199	250 (min.)	mm
Mass/Area (Geotextile)	D5261	6.0 (min.)	oz/sy

Notes:

- (1) Transmissivity testing shall be performed using a gradient of 0.1, a confining pressure of one-thousand (1,000) pounds-per-square-foot (psf), and a minimum seating time of one (1) hour. The geocomposite shall be bounded by a moderately compacted sample of cap cover soil and a 40-mil textured geomembrane.
- (2) Minimum residual interface friction between the geocomposite and 40-mil textured geomembrane. Confining pressures at 100, 250, and 500 psf. with saturated interface. Note that all three geosynthetic components can be tested in one series of tests.
- ** Minimum values unless otherwise noted for manufacturer's quality control testing. All values minimum for field conformance testing.

2.03 GEOCOMPOSITE ROLLS

- A. Geocomposite shall be provided in rolls not less than fifteen (15) feet in width.
- B. Each roll shall be identified by a number and date of manufacture. Labels or markers used for identification shall be of a type which will not degrade the liner material. The labels shall contain, at a minimum, the following information:
 1. Manufacturer's name.
 2. Product identification.
 3. Nominal thickness.
 4. Roll Number.
 5. Lot/Batch Number.
 6. Roll Dimensions.

2.04 QUALITY CONTROL DOCUMENTATION

- A. Prior to installation of any geocomposite, the manufacturer or CONTRACTOR shall provide the QAO with the following documentation:
 1. The origin (supplier's name and production plant), identification (brand name and number), and production date of resin used to manufacture the geotextile and geonet components.
 2. Copies of dated quality control certificates issued by the resin suppliers.
 3. Specifications for the geotextile, geonet, and geocomposite which include all properties listed in Article 2.02.C of this Section measured using the specified test methods.
 4. Written certification that the minimum values given in the specification are guaranteed by the manufacturer.
 5. Quality control certificates, signed by a responsible party employed by the manufacturer, indicating product designation, roll number identification, date of manufacturer, resin batch identification, testing procedures, and the results of all quality control tests. At a minimum, the tests listed in Article 2.02.C shall be performed.

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- B. Geocomposite samples shall be tested and receive favorable review of test results by the QAO prior to shipment to ensure that the properties of the finished product are in accordance with the Specifications. Samples of geocomposite rolls shall be tested by the manufacturer at the CONTRACTOR's expense. Samples will be tested by the manufacturer at a frequency of one (1) sample for every 90,000 ft² of material produced for each lot and material type. The required material properties, test methods, values, and units are presented in Article 2.02.C of this Section.
- C. In addition, one (1) sample 3-foot-wide by the width of the roll, from each roll tested, will be retained by the manufacturer or CONTRACTOR for possible further testing until construction for which the geocomposite is used is complete and favorably reviewed by the QAO. Each sample of geocomposite will have the roll number, lot number, date of manufacture, machine direction, and manufacturer name clearly marked on or attached to the sample.
- D. All quality control test results shall be reviewed by the QAO for conformance with the minimum properties listed in Article 2.02.C of this Section. Any nonconformance shall be reported to the GROUP's REPRESENTATIVE and shall be the basis of rejection of the nonconforming rolls.
- E. The CONTRACTOR shall be solely responsible for the quality of the material provided. Should any of the tests performed on the material yield unsatisfactory results, the CONTRACTOR will be responsible for replacing the material with satisfactory materials without delay to the Work and at CONTRACTOR's sole expense.
- F. The CONTRACTOR, in accordance with Part 4 of this Section, shall perform quality control during construction.

2.05 CONFORMANCE TESTING

- A. Upon delivery of the material to the Site, the QAO shall obtain conformance test samples from selected geocomposite rolls at a minimum frequency of one sample per 100,000 ft², or one per lot, whichever results in a higher frequency, to verify conformance with the project specifications. Alternatively, samples may be obtained at the manufacturing facility prior to material delivery to the Site, if desired by the GROUP's REPRESENTATIVE.
- B. Samples shall be 3-foot-wide by the entire width of the roll and shall be obtained after the first three (3) feet (or more if material is damaged as determined by the QAO) of the roll has been removed. Samples shall be marked with "machine direction" indicated prior to shipment to the laboratory.
- C. Conformance testing shall be performed by a qualified geosynthetic materials testing laboratory approved by the GROUP's REPRESENTATIVE and the QAO.

- D. The following conformance tests shall be performed for geocomposite:
- | | | |
|----|----------------------------------|--------------------|
| 1. | Geonet Thickness | ASTM D5199 |
| 2. | Geonet/Geotextile Ply Adhesion | ASTM F904 Modified |
| 3. | Geotextile AOS (upper component) | ASTM D4751 |
| 4. | Geocomposite Transmissivity* | ASTM D4716 |
- *Pressure of 1,000 psf, gradient of 0.1, and seating time of 1 hour
- E. All conformance test results shall be reviewed by the QAO for conformance with the minimum physical properties listed in Article 2.02.C of this Section. Any nonconformance shall be reported to the GROUP's REPRESENTATIVE and shall be the basis of rejection of the nonconforming rolls.
- F. If a test result does not meet the project specifications, all material from the lot or batch represented by the failing sample shall be considered out-of-specification and rejected. Alternatively, at the option of the QAO, additional conformance test samples may be taken to bracket the portion of the batch not meeting the specification. This procedure is valid only when all rolls in the batch are consecutively produced and numbered from one manufacturing line. To isolate out-of-specification material, additional samples shall be taken from rolls which have numbers immediately adjacent (or the next roll number present on-Site from the same batch) to the roll that was initially sampled and failed. If both additional tests pass, the roll that represents the initial failed test and the roll manufactured immediately after that roll (next larger roll number), if present on-Site, shall be rejected. If one or both of the additional tests fail, then the entire batch shall be rejected or this procedure repeated with two additional tests that bracket a greater number of rolls within the batch. All additional testing shall be at the cost to the manufacturer.

PART 3 - EXECUTION

3.01 GEOCOMPOSITE INSTALLATION

- A. Install the geocomposite drainage layer over the geomembrane to the limits shown on the Contract Drawings in accordance with the manufacturer's recommendations. Do not cover the geomembrane until the geomembrane installation and test results for that area of work have been favorably reviewed by the QAO.
- B. Protect the geomembrane during the installation of the geocomposite layer. No equipment shall be permitted to operate directly on the geomembrane or geocomposite at any time. In no way shall any tracked equipment or any other equipment which may pose a risk of puncturing, tearing, or otherwise damaging

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the geomembrane or geocomposite be permitted to operate directly on these materials. Provide a minimum twelve (12) inches of compacted soil separation between the geocomposite and low ground pressure equipment (maximum 5 psi) as described in Section 02224 of these Specifications.

- C. The CONTRACTOR and/or Installer shall supply and use a sacrificial smooth geomembrane to aid in the deployment and positioning of geocomposite panels over the textured geomembrane unless an alternate method has been favorably reviewed by the QAO, in accordance with Article 1.03 of this Section, prior to deployment.
- D. The geocomposite shall be positioned by hand after being unrolled. Do not crease or fold over the geocomposite. Geocomposite seams shall be along the slope, not across, on all slopes steeper than ten (10) percent, except as part of a patch.
- E. The installed geocomposite shall be weighted with sandbags, or equivalent method favorably reviewed by the QAO, during placement and shall remain until replaced with cover material.
- F. The geotextile and geonet components shall each be overlapped and joined individually along all seams such that the geonet forms a continuous layer unimpeded by the geotextile components. Adjacent rolls shall be overlapped a minimum of four (4) inches and the edges of the geonet secured by plastic ties a minimum of every five (5) feet along the roll length. On cross-slope seams or at the end of panel seams, the geonet will be overlapped a minimum of twelve (12) inches and securely fastened together with ties at maximum 6-inch intervals. Plastic ties shall be white or other bright and contrasting color for ease of inspection and shall be connected according to the manufacturer's recommendations. Metallic ties are not permitted. The edges of upper geotextile shall then be sewn along their entire length. The bottom geotextile sheets (where applicable) shall be overlapped without sewing.
- G. The geocomposite shall not be welded or otherwise physically attached to the geomembrane.
- H. All connections shall be inspected and favorably reviewed by the QAO. The QAO will reject any connections deemed insufficient and require those joints to be redone at the CONTRACTOR's expense.
- I. Repairs shall be made in accordance with the manufacturer's procedures and recommendations at the CONTRACTOR's expense. The CONTRACTOR shall submit proposed repair procedures for the favorable review of the QAO.

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3.02 PROTECTION

- A. After installation, visually inspect the geocomposite to assure that no objects are present that could potentially harm the geocomposite.
- B. Any geocomposite damaged during installation or during placement of cover material shall be replaced by the CONTRACTOR at the CONTRACTOR's expense.
- C. The Work shall be scheduled so that the covering of the geocomposite is accomplished within than the manufacturer's recommendations for maximum exposure of the geotextile, but in no case over thirty (30) calendar days after initial placement of the geocomposite. Failure to comply with this requirement shall require replacement of the geocomposite at the CONTRACTOR's expense.
- D. No equipment shall be operated directly on the geocomposite prior to the placement of overlying materials. Provide a minimum soil separation of twelve (12) inches between the geocomposite and low ground pressure equipment (maximum 5 psi) or as listed in Section 02224.

PART 4 - QUALITY ASSURANCE/QUALITY CONTROL

4.01 GENERAL

- A. The CONTRACTOR, before installation begins, shall appoint an experienced supervisor thoroughly experienced with work similar to the requirements specified herein, and who will be on-Site at all times during the installation, to represent the CONTRACTOR in all matters relevant to this Work. This supervisor shall be subject to favorable review by the QAO.
- B. Any changes in the proposed method of work, SUBCONTRACTORS to be utilized, geocomposite, geotextile, resin or manufacturing must be favorably reviewed in advance by the QAO. The CONTRACTOR assumes all responsibility relevant to providing an acceptable product and installation.

4.02 QUALITY ASSURANCE/QUALITY CONTROL DURING INSTALLATION

- A. The CONTRACTOR and QAO shall visually inspect all material to be included in the Work for transport damage and uniformity and compare roll identification numbers with those on the certification provided by the manufacturer to assure delivery of the appropriate material.
- B. The CONTRACTOR and QAO shall also visually inspect the material for any damage incurred as a result of handling or on-Site storage.

- C. After the CONTRACTOR has completed each area of work and thoroughly inspected all installation and seaming, the QAO will visually inspect all seams for continuity and quality. Do not cover any geocomposite prior to receiving favorable review from the QAO. All inadequate seams shall be repaired at the CONTRACTOR's expense.

4.02 WARRANTIES

- A. The manufacturer shall warranty that all geocomposite materials are free from manufacturing defects in material and workmanship for a period of five years following shipment to the Site.
- B. The CONTRACTOR/INSTALLER shall warranty all work, including the material and all workmanship, for a period of two years following final acceptance by the GROUP.

*****END OF SECTION*****

SECTION 02613

CORRUGATED METAL PIPE

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall furnish all labor, materials, equipment, tools and appurtenances required to complete the work of furnishing and installing corrugated metal pipe (CMP) as shown, specified, and as otherwise required by the Contract Documents.
- B. The CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations and laws of local, municipal, Commonwealth, or Federal authorities having jurisdiction. The CONTRACTOR shall provide a “Competent Person” to implement, supervise, and inspect the work.

1.02 RELATED SECTIONS

- A. Section 02150 – Shoring and Bracing
- B. Section 02220 – Excavation
- C. Section 02223 – Backfill and Fill
- D. Section 02274 – Stone Riprap

1.03 SUBMITTALS

- A. The CONTRACTOR shall submit Shop Drawings, catalog cuts, and MANUFACTURER’s literature for all pipe and pipe fittings including information on coatings and linings, material specifications, dimensions, tolerances, and all related data. No material shall be installed prior to furnishing this required information and receiving favorable review.
- B. The CONTRACTOR shall furnish the MANUFACTURER’s material certificates for all pipe, fittings, and accessories supplied under this Section, demonstrating that the requirements of this Section have been met.
- C. Submit to the GROUP’s REPRESENTATIVE in accordance with Section 01300 of these Specifications.

1.04 QUALITY ASSURANCE

- A. Pipe installation shall be done by skilled workers. Each pipe laying crew shall have a pipe laying foreman.

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- B. Accurately install pipe to the lines and grades shown on the Contract Drawings, or as directed by the GROUP's REPRESENTATIVE, so that inverts are smooth.
- C. A full circle shall be visible at the far end, when looking through pipes, unless bends are specified or shown in the Contract Documents.
- D. Deflections at joints are not permitted without prior written consent from the GROUP's REPRESENTATIVE.
- E. The GROUP's REPRESENTATIVE shall be notified whenever an existing pipeline location or other existing feature conflicts with the proposed locations of the Work.
- F. Pipe and fittings of the same type shall be the products of a single manufacturer.
- G. All piping shall be of the type and size as described in the Contract Documents.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. All pipes and fittings shall be carefully handled when loading and unloading. Lift by hoists or lower on skidways in a manner to avoid shock. Avoid damaging the pipe and its coating or lining if present.
- B. Where required, due to weight of material and for the safety and protection of workmen, materials, equipment, property, and the Work, use derricks, ropes, or other suitable equipment for lowering pipe into trenches. Take particular care to avoid damaging the pipes.
- C. Store piping and related materials so as to cause the least possible interference with the Work, Site operations, public thoroughfares, and the public in general. Should the GROUP's REPRESENTATIVE so direct, relocate such material and/or equipment, which are creating an interference or inconvenience. Relocate such material or equipment which is obstructing the Site or interfering or obstructing other operations or activities of the GROUP's REPRESENTATIVE.
- D. The MANUFACTURER's recommended procedures for pipe stacking shall be followed. When pipes are stacked for storage, the heaviest series of pipe shall be placed at the bottom.
- E. If any defective pipes are discovered after being laid or placed, removal and replacement with a sound pipe will be required at the CONTRACTOR's sole expense.

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PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Acceptable MANUFACTURERS of corrugated metal pipe, fittings, and appurtenances shall be members of the National Corrugated Steel Pipe Association.

2.02 MATERIALS

- A. All pipe delivered to the Site shall be clearly marked at the factory with the MANUFACTURER's identification and all else as required by the codes, standards, and specifications referred to under this Section. Omission of this information will be cause for rejection of pipe.

2.03 CORRUGATED METAL PIPE

- A. Pipe and Fittings: Comply with AASHTO M36 and M190, as modified herein. Helical corrugations with continuous lock or welded seams. Riveted, lap joint construction is acceptable only with the prior written approval from the GROUP's REPRESENTATIVE, and shall have rivets located in the inside valley of the corrugations.
- B. Base Metal: Galvanized steel.
- C. Metal Gauge: Pipe shall have 2-2/3 inches by 1/2-inch corrugation and be a minimum of 16-gauge.
- D. Joints: Galvanized steel, 12-inch wide minimum, 16-gauge minimum, bolted coupling bands. Joints for sub-aqueous pipe shall be stainless steel rods and hardware.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Thoroughly clean pipe and fitting interiors, joint surfaces, and gaskets prior to installation. Maintain pipes and fittings clean.

3.02 INSPECTION

- A. Each length of pipe and each fitting shall be carefully inspected prior to lowering into trench. All materials not meeting the requirements of these Specifications, or otherwise found defective or unsatisfactory by the GROUP's REPRESENTATIVE, shall be rejected and immediately marked and removed from the Site by CONTRACTOR. The CONTRACTOR shall provide suitable

replacement materials, conforming to these Specifications, at no additional cost to the GROUP.

- B. Bedding, subgrade, and other trench conditions shall be carefully inspected prior to laying pipe in each stretch of open trench. All conditions shall be made available to the GROUP's REPRESENTATIVE for inspection purposes, and the GROUP's REPRESENTATIVE shall be further advised where, in CONTRACTOR's opinion, unstable or otherwise deleterious conditions exist.
- C. Pipes shall be installed in the locations and to the required lines and grades as shown on the Contract Drawings and as provided in these Specifications, using a method of control, which has been favorably reviewed by the GROUP's REPRESENTATIVE. The GROUP's REPRESENTATIVE and the QAO have the authority to order the removal or relaying of all pipe laid contrary to the Specifications.

3.03 LAYING OF PIPE

- A. The laying of pipe shall begin at the downstream end of the pipeline. The lower segment of the pipe shall be in firm contact with the bedding throughout its full length.
- B. The pipe bedding shall meet the requirements of Backfill in Section 02223 of these Specifications and shall be placed to conform to pipe shape.

3.04 PIPE INSTALLATION

- A. Pipes and fittings shall be carefully lowered into the trench.
- B. Pipe and fittings shall be installed so that there will be no deviation at the joints. Pipe and fittings which do not fit together to form a tight fitting joint are not permitted.
- C. Pipes shall be installed in the locations and to the required lines and grades as shown in the Contract Documents. The GROUP's REPRESENTATIVE have the authority to order the removal or relaying of all pipe laid contrary to the Specifications.
- D. Excavate, support, and dewater pipe trenches in accordance with Sections 02150, 02220 and 02221 of these Technical Specifications. Excavations shall be maintained free of water during the progress of the Work. All slides or cave-ins of the trenches or cuts shall be remedied to the satisfaction of the GROUP's REPRESENTATIVE.
- E. Maintain cleanliness of installed pipe and fittings interiors throughout the Work. Plug ends when pipe installation is not in progress. Remove all plugs as required

to place pipe into operation. Drainage of construction excavations through new pipes is prohibited.

- F. All adjustments to the line and grade of pipe shall be done by scraping away or filling in the bedding under the barrel of the pipe, and not by blocking or wedging. Where additional bedding is required due to excessive excavation by the CONTRACTOR, it shall be provided at the CONTRACTOR's sole expense. In all cases, the trench under the joint shall be excavated and suitably shaped to permit an even bearing for the barrel of the pipe. The minimum depth of bedding, as shown in the Contract Documents, shall be maintained at all times.
- G. When unsuitable materials or conditions are encountered, excavate below grade until suitable foundation is encountered and the trench backfilled with compacted gravel or crushed stone foundation.
- H. Where required, holes and spaces to be used for joints shall be sufficiently large to leave the joint of each pipe free and not resting on the ground at any point. Every joint shall be made up in the trench.
- I. Install fittings as required and in accordance with the Contract Documents, Specifications, and the manufacturer's installation instructions. The installation of fittings after the pipeline has been laid will not be permitted without the approval of the GROUP's REPRESENTATIVE. In such cases, complete details pertaining to the proposed type of fittings and the installation procedure shall be submitted by the CONTRACTOR to the GROUP's REPRESENTATIVE before approval will be considered.
- J. Approval by the GROUP's REPRESENTATIVE is required prior to changing the location of any of the Work due to field conditions. Changes in pipe sizes are prohibited without written consent from the GROUP's REPRESENTATIVE.
- K. All installed piping shall form completely connected systems, including connections to valves, equipment, structures, existing facilities, and appurtenances specified in other Sections to result in a satisfactorily operating installation.
- L. Since submergence of the empty pipeline could cause flotation, the CONTRACTOR shall conduct operations in such a manner as to prevent flooding of the trenches until the backfill has been placed. Where there is a danger of flooding prior to placing sufficient backfill, the pipe shall be adequately braced to prevent flotation. The CONTRACTOR shall be responsible for relaying all pipe damaged or moved from proper line and grade by flotation.
- M. Backfill pipes in accordance with Section 02223 of these Specifications.

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3.05 ADJUST AND CLEAN

- A. All sections of piping found defective in material, alignment, grade, joints, or otherwise, shall be corrected to the satisfaction of the GROUP's REPRESENTATIVE.
- B. Leave all the pipes and connections watertight.
- C. Upon completion of construction of pipelines and appurtenances, all pipelines shall be thoroughly flushed out with water, and all temporary plugs shall be removed. Flushing shall be executed in such manner that dirt or other material will not be discharged into existing watercourses. Clean piping in accordance with Section 01666.

*****END OF SECTION*****

SECTION 02614

CORRUGATED POLYETHYLENE PIPE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall furnish all labor, materials, equipment, tools and appurtenances required to complete the Work of furnishing and installing polyethylene drainage pipe as shown, specified, and as otherwise required by the Contract Documents.
- B. The CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations and laws of local, municipal, state, or Federal authorities having jurisdiction. The CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect the work.

1.02 RELATED SECTIONS

- A. Section 02150 – Shoring and Bracing
- B. Section 02220 – Excavation
- C. Section 02221 – Waste Excavation and Relocation
- D. Section 02223 – Backfill and Fill
- E. Section 02233 – Aggregate
- F. Section 02274 – Stone Riprap

1.03 SUBMITTALS

- A. The CONTRACTOR shall submit Shop Drawings, catalog cuts, and MANUFACTURER's literature for all pipe and pipe fittings including information on coatings and linings, material specifications, dimensions, tolerances, and all related data. No material shall be installed prior to furnishing this required information and receiving favorable review from the GROUP'S REPRESENTATIVE.
- B. The CONTRACTOR shall furnish the MANUFACTURER's material certificates for all pipe, fittings, and accessories supplied under this Section demonstrating that the requirements of this Section have been met.
- C. Submit to the GROUP'S REPRESENTATIVE in accordance with Section 01300 of these Specifications.

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1.04 QUALITY ASSURANCE

- A. Pipe installation shall be done by skilled workers. Each pipe laying crew shall have a pipe laying foreman.
- B. Accurately install pipe to the lines and grades shown on the Contract Drawings, or as directed by the GROUP'S REPRESENTATIVE and/or QUALITY ASSURANCE OFFICER (QAO), so that inverts are smooth.
- C. A full circle shall be visible at the far end, when looking through pipes, unless bends are specified or shown in the Contract Documents.
- D. Deflections at joints are not permitted without prior written consent from the GROUP'S REPRESENTATIVE.
- E. The GROUP'S REPRESENTATIVE shall be notified whenever an existing pipeline location or other existing feature conflicts with the proposed locations of the Work.
- F. When requested by the GROUP'S REPRESENTATIVE, a qualified field representative of the manufacturer shall be present at the jobsite for the first day of pipe laying to assure that proper procedures are followed.
- G. Pipe and fittings of the same type shall be the products of a single MANUFACTURER.
- H. All piping shall be of the type and size as described in the Contract Documents.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. All pipes and fittings shall be carefully handled when loading and unloading. Lift by hoists or lower on skidways in a manner to avoid shock. Avoid damaging the pipe and its coating or lining if present.
- B. Where required, due to weight of material and for the safety and protection of workmen, materials, equipment, property, and the Work, use derricks, ropes, or other suitable equipment for lowering pipe into trenches. Take particular care to avoid damaging the pipes.
- C. Store piping and related materials so as to cause the least possible interference with the Work, Site operations, streets, sidewalks, driveways, other thoroughfares, parking areas, delivery areas, business areas, and the public in general. Should the GROUP'S REPRESENTATIVE so direct, relocate such material and/or equipment, which is creating an interference or inconvenience. Relocate such material or equipment which is obstructing the Site or interfering

or obstructing other operations or activities of the GROUP'S REPRESENTATIVE or QAO.

- D. The MANUFACTURER's recommended procedures for pipe stacking shall be followed. When pipes are stacked for storage, the heaviest series of pipe shall be placed at the bottom.
- E. If any defective pipes are discovered after being laid or placed, removal and replacement with a sound pipe will be required at the CONTRACTOR's sole expense.
- F. Corrugated polyethylene pipe and fittings shall be protected from damage by sharp objects through all phases of work.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. All pipe delivered to the Site shall be clearly marked at the factory with the MANUFACTURER's identification and all else as required by the codes, standards, and specifications referred to under this Section. Omission of this information will be cause for rejection of pipe.

2.02 POLYETHYLENE PIPE

- A. Pipe shall be Advanced Drainage System, Inc. (ADS) N-12, polyethylene pipe, or approved equal.
- B. The pipe shall have a full circular cross section, with an outer corrugated wall and an essentially smooth inner wall, and shall meet the requirements of AASHTO Specifications M252 and M294 for pipe classification "Type S". Corrugations shall be annular.
- C. Pipes shall be fabricated from virgin polyethylene compounds which conform to the requirements of cell class 335420C as defined and described in ASTM D3350, except that carbon black content shall not exceed 5 percent. Compounds that have higher cell classifications in one or more properties are acceptable provided product requirements are met.
- D. Joints between corrugated pipe sections shall consist of ADS ProLine™ WT, N-12 molded high-density polyethylene bell/bell couplers, which are water tight, cleated, and have an integral gasket, or approved equal.
- E. Joints and fittings shall be fabricated from virgin polyethylene compounds which conform to the requirements of cell class 335420C as defined and described in

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ASTM D3350, except that carbon black content shall not exceed five (5) percent. Compounds that have higher cell classifications in one or more properties are acceptable provided product requirements are met.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Thoroughly clean pipe and fitting interiors, joint surfaces, and gaskets prior to installation. Maintain pipes and fittings clean.

3.02 INSPECTION

- A. Each length of pipe and each fitting shall be carefully inspected prior to lowering into trench. All materials not meeting the requirements of these Specifications, or otherwise found defective or unsatisfactory by the GROUP'S REPRESENTATIVE and/or QAO, shall be rejected and immediately marked and removed from the Site by CONTRACTOR. The CONTRACTOR shall provide suitable replacement materials, conforming to these Specifications, at no additional cost to the GROUP.
- B. Bedding, subgrade, and other trench conditions shall be carefully inspected prior to laying pipe in each stretch of open trench. All conditions shall be made available to the QAO for inspection purposes, and the GROUP'S REPRESENTATIVE and QAO shall be further advised where, in CONTRACTOR's opinion, unstable or otherwise deleterious conditions exist. Pipe bedding shall be in accordance with Section 02223 - Backfill and Fill.
- C. Pipes shall be installed in the locations and to the required lines and grades as shown on the Contract Documents and as provided in these Specifications, using a method of control favorably reviewed by the GROUP'S REPRESENTATIVE. The GROUP'S REPRESENTATIVE and the QAO have the authority to order the removal or relaying of all pipe laid contrary to the Specifications.

3.03 LAYING OF PIPE

- A. The laying of pipe shall begin at the downstream end of the pipeline. The lower segment of the pipe shall be in firm contact with the bedding throughout its full length.
- B. The pipe bedding shall meet the requirements of Backfill and Fill in Section 02223 of these Technical Specifications and shall be placed to conform to pipe shape.

3.04 PIPE INSTALLATION

- A. Pipes and fittings shall be carefully lowered into the trench.
- B. Pipe and fittings shall be installed so that there will be no deviation at the joints. Pipe and fittings which do not fit together to form a tight fitting joint are not permitted.
- C. Pipes shall be installed in the locations and to the required lines and grades as shown on the Contract Drawings and provided in these Specifications, using a method of control favorably reviewed by the GROUP'S REPRESENTATIVE. The GROUP'S REPRESENTATIVE and the QAO has the authority to order the removal or relaying of all pipe laid contrary to the Specifications.
- D. Excavate, support, and dewater pipe trenches in accordance with Sections 02150, 02220, and 02221 of these Specifications. Excavations shall be maintained free of water during the progress of the Work. All slides or cave-ins of the trenches or cuts shall be remedied to the satisfaction of the GROUP'S REPRESENTATIVE and the QAO.
- E. Maintain cleanliness of installed pipe and fittings interiors throughout the Work. Plug ends when pipe installation is not in progress. Remove all plugs as required to place pipe into operation. Drainage of construction excavations through new pipes is prohibited.
- F. All adjustments to the line and grade of pipe shall be done by scraping away or filling in the bedding under the barrel of the pipe and not by blocking or wedging. Where additional bedding is required, it shall be provided at the CONTRACTOR's sole expense. In all cases, the trench under the joint shall be excavated and suitably shaped to permit an even bearing for the barrel of the pipe. The minimum depth of bedding, as shown on the Contract Drawings, shall be maintained at all times.
- G. When unsuitable materials or conditions are encountered, excavate below grade until suitable foundation is encountered and the trench backfilled with compacted gravel or crushed stone foundation.
- H. Where required, holes and spaces to be used for joints shall be sufficiently large to leave the joint of each pipe free and not resting on the ground at any point. Every joint shall be made up in the trench.
- I. Install fittings as required and in accordance with the Contract Drawings, Specifications, and the MANUFACTURER's installation instructions. The installation of fittings after the pipeline has been laid will not be permitted without the approval of the GROUP'S REPRESENTATIVE. In such cases, complete details pertaining to the proposed type of fittings and the installation

procedure shall be submitted by the CONTRACTOR to the GROUP'S REPRESENTATIVE before approval will be considered.

- J. Approval by the GROUP'S REPRESENTATIVE is required prior to changing the location of any of the Work due to field conditions. Changes in pipe sizes are prohibited without written consent from the GROUP'S REPRESENTATIVE.
- K. All installed piping shall form completely connected systems including connections to valves, equipment, structures, existing facilities, and appurtenances specified in other Sections to result in a satisfactorily operating installation.
- L. Since submergence of the empty pipeline could cause flotation, the CONTRACTOR shall conduct operations in such a manner as to prevent flooding of the trenches until the backfill has been placed. Where there is a danger of flooding prior to placing sufficient backfill, the pipe shall be adequately braced to prevent flotation. The CONTRACTOR shall be responsible for relaying all pipe damaged or moved from proper line and grade by flotation.
- M. Backfill pipe in accordance with Section 02223 of these Specifications.

3.05 ADJUST AND CLEAN

- A. All sections of piping found defective in material, alignment, grade, joints, or otherwise, shall be corrected to the satisfaction of the GROUP'S REPRESENTATIVE and/or QAO.
- B. Leave all the pipes and connections watertight.
- C. Upon completion of construction of pipelines and appurtenances, all pipelines shall be thoroughly flushed out with water and all temporary plugs shall be removed. Flushing shall be executed in such manner that dirt or other material will not be discharged into existing watercourses. Clean piping in accordance with Section 01666.

***** END OF SECTION *****

SECTION 02615

HIGH DENSITY POLYETHYLENE PIPE

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. CONTRACTOR shall furnish all labor, materials, equipment, tools and appurtenances required to complete the work of furnishing and installing High Density Polyethylene (HDPE) piping, as shown and specified in the Contract Documents and Contract Drawings.
- B. Piping shall be fabricated and installed for operating ranges as follows:
 - 1. Temperature Range: -40°F to 150°F
 - 2. Pressure Range: Full Vacuum to 100 psig

1.02 RELATED SECTIONS

- A. 02233 – Aggregate Materials
- B. 02599 – Geocomposite Drainage Layer

1.03 SUBMITTALS

- A. Before beginning pipe installation, the CONTRACTOR shall furnish MANUFACTURER's certificates that state that the pipes, valves, fittings, and other materials meet this specification. The CONTRACTOR shall prepare and submit to the QUALITY ASSURANCE OFFICER (QAO) MANUFACTURERS' information (catalog cuts and/or shop drawings) for each type of pipe, valve, and fitting to be furnished.
- B. Shop drawings shall show plans of the piping system, indicating the type and location of all pipe, fittings, and joints to be used, size and length of pipe, size of valves, and the manner in which piping systems shall be supported. All pipe supports, pipe couplings, and specials shall be clearly shown, indicating size, length, and other necessary dimensions.
- C. Shop drawings shall be submitted to the GROUP'S REPRESENTATIVE and approved prior to delivery of any material to the site.
- D. Prior to beginning pipe installation, the CONTRACTOR shall submit to the GROUP'S REPRESENTATIVE for approval a measurement recording form for use during pressure testing.

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- E. Provide: a 4-inch length of each piping type including cross-section sample of a properly prepared joint; and a 4-inch length of each type of metallic locating tape.
- F. Submit above in accordance with Section 01300.

1.04 QUALITY ASSURANCE

- A. MANUFACTURERS: Firms regularly engaged in manufacture of HDPE pipe, tube, and fittings of types and sizes required.
- B. CONTRACTOR's personnel installing, inspecting, and testing HDPE shall be certified by pipe MANUFACTURER within one year prior to pipe installation. All necessary training shall be performed by pipe MANUFACTURER's representative, at CONTRACTOR's expense.
- C. Pipe shall be accurately routed to the locations shown on the Contract Drawings.
- D. Deflections in horizontal alignment at joints are not permitted without the written consent of the GROUP'S REPRESENTATIVE. If so approved, the deflections shall not exceed one-half the MANUFACTURER's recommendation.
- E. Pipe and fittings of the same type shall be the products of a single MANUFACTURER.
- F. Pipe Adapters – Join pipes of different materials with adapters specifically manufactured for that purpose and favorably reviewed by the GROUP'S REPRESENTATIVE, or as detailed on the Contract Drawings.
- G. All piping shall be of the type and size shown on the Contract Drawings and described in this Section of the Specifications. All underground piping shall be HDPE unless otherwise noted on the Contract Drawings or favorably reviewed by the GROUP'S REPRESENTATIVE in writing.
- H. Pipe and fittings shall be protected against the damaging ultraviolet rays of the sun when stored for any period. Such protection shall consist of canvas covering, or other material as recommended by the MANUFACTURER. Plastic sheets shall not be used that may allow excessive temperatures to develop where pipe is stored. All pipe, which has been distorted or otherwise negatively affected by high temperatures, shall be rejected, regardless of the pipe's appearance after return to ambient temperatures. Rejected pipe shall be removed from the site of the work at the sole expense of the CONTRACTOR.
- I. The MANUFACTURER's recommended procedures for pipe stacking shall be followed. When pipe is stacked for storage, the heaviest series of pipe shall be placed at the bottom.
- J. Pipe and fittings shall be protected from damage by sharp objects through all phases of work.

- K. If any defective pipe is discovered after being laid or placed, removal and replacement with a sound pipe will be at the sole expense to the CONTRACTOR or the CONTRACTOR's subcontractor.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

- A. Piping resins shall be high performance, high molecular weight, high density polyethylene conforming to ASTM D1248 (Type III, Class C, Category 5, Grade P34), and ASTM D3350 (Cell Classification PE345434C). The pipe and fittings shall be manufactured from pre-compounded resin manufactured by the pipe MANUFACTURER, with a minimum of two-percent carbon black to withstand outdoor exposure without loss of properties. In plant blending of non-compounded resins is not acceptable. All polyethylene pipes shall meet the requirements of ASTM F714 for SDR 17.0 High Density Polyethylene (HDPE) pipe as shown on the Contract Drawings. Pipe shall be furnished non-perforated, as required by the application. Each pipe length shall be marked with the MANUFACTURER's name or trademark, size, material code, and standard dimension ratio. All fittings shall be molded.
- B. The pipe shall contain no recycled compound except that generated in the MANUFACTURER's own plant from resin of the same specification from the same raw material. The pipe shall be homogeneous throughout and free of visible cracks, holes (other than those manufactured), foreign inclusions, or other deleterious defects, and shall be identifiable in color, density, melt index, and other physical properties.
- C. The polyethylene pipe MANUFACTURER shall provide certification that stress regression testing has been performed on the specific product. This stress regression testing shall have been done in accordance with ASTM D2837, Class PE3408, and the MANUFACTURER shall provide a product supplying a minimum hydrostatic design basis (HDB) of sixteen-hundred (1,600) psi at 63.4 degrees Fahrenheit, as determined in accordance with ASTM D2837.
- D. Each pipe shall meet the following cell classification standards:
- | | |
|--|---|
| Flexural Modulus: | 110,000 to 160,000 psi |
| Tensile Strength: | 3,000 to < 3,500 psi |
| Environmental Stress Crack Resistance: | Test Condition C
Test Duration 192 hours
Maximum % Failure = 20 |
| Hydrostatic Design Basis (23°C) | 1,600 psi |

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2.02 PIPING ACCESSORIES

- A. Bolts, nuts and washers: Type 304 or 316 stainless steel, and not smaller than 1/4-inch; bolts shall have hexagonal heads and nuts shall be hexagonal.
- B. Fittings that unite dissimilar metals shall be dielectric insulating type.
- C. CONTRACTOR shall provide necessary HDPE spacers, as required to provide adequate clearance for the proper installation of the specified valves and equipment.
- D. Flanged connections to valves, equipment and other piping materials shall be made with a HDPE stub-end flange adapter and epoxy coated carbon steel backing unless otherwise approved by GROUP'S REPRESENTATIVE.
- E. Above ground HDPE shall be continuously supported from underneath using a flat piece of steel or uni-strut and be attached to the underneath support at periodic intervals in accordance with the HDPE pipe manufacture's written recommendations.

PART 3 - EXECUTION

3.01 QUALITY CONTROL

- A. Each length of pipe and each fitting shall be carefully inspected prior to lowering into trench. All materials not meeting the requirements of these Specifications, or otherwise found defective or unsatisfactory by the GROUP'S REPRESENTATIVE, shall be rejected and immediately marked and removed from the job site.
- B. Bedding, sub-grade, and other trench conditions shall be carefully inspected prior to laying pipe in each stretch of open trench. All conditions shall be made available to GROUP'S REPRESENTATIVE for inspection purposes, and GROUP'S REPRESENTATIVE shall be further advised where, in CONTRACTOR's opinion, unstable or otherwise deleterious conditions exist.
- C. The piping shall be installed in complete sections from high points to low points.
- D. Each stretch of completed pipeline shall be inspected and direction verified prior to backfilling. Backfilling operations shall not be initiated prior to inspection and favorable review by GROUP'S REPRESENTATIVE.
- E. The CONTRACTOR shall arrange pipe installation, testing, and backfill to minimize the amount of time and length of open trenches. When trenches are to be left open overnight, they should be covered with plywood and plastic sheeting.

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3.02 PREPARATION

- A. Pipe and fitting interiors and joint surfaces, shall be thoroughly cleaned prior to installation. Pipe and fittings shall be maintained clean.

3.03 PIPE INSTALLATION

- A. Pipes and fittings shall be carefully lowered into the trench.
- B. Pipe and fittings shall be installed so that there will be no deviation at the joints and so that inverts present a smooth surface. Pipe and fittings which do not fit together to form a tight fitting joint are not permitted.
- C. Unless noted on Contract Documents, all HDPE joints shall be butt-fusion welded. Butt-fusion welds shall be performed as follows unless otherwise recommended by the pipe MANUFACTURER:
 - 1. Clean pipe ends inside and outside with a clean rag to remove dirt, water, grease, and other foreign materials.
 - 2. Square cut end of each pipe section with the facing tool of the fusion machine or plastic pipe cutters. Remove cuttings and burrs from pipe ends.
 - 3. Check lineup of pipe ends in the fusion machine to ensure that pipe ends meet squarely and completely over entire surface to be fused. Proper alignment is necessary to obtain uniform heating of the pipe ends and uniform bead at fused joint.
 - 4. Heater Plate:
 - a. Insert the heater plate between the aligned pipe ends. Bring and hold pipe ends in contact with heater plate.
 - b. Maintain contact without pressure and allow pipe to heat and soften approximately:
 - (1) 1/8 inch back from pipe end for 2-inch pipe.
 - (2) 3/16 inch back from pipe end for 3-inch and larger pipe.
 - c. Heater thermometer reading shall be between:
 - (1) 500°F and 575°F on coated plates.
 - (2) 475°F and 500°F on uncoated plates.
 - d. Double check heater plate temperature with a tempilstik or pyrometer for correct surface temperature.
 - e. Carefully move pipe ends away from heater plate and remove plate.

- f. If softened material sticks to plate, discontinue the joint. Clean heater plate, resquare pipe ends, and start over.
- 5. Flash Bead:
 - a. Bring heated pipe ends together with firm pressure per MANUFACTURER's recommendation to form a uniform upset flash bead approximately 1/8 inch to 3/16 inch wide around entire circumference of pipe.
 - b. Bead will have appearance of double upset flash.
 - c. Pressure is necessary to cause heater material to flow together, which gives the fusion bead an appearance that is distinctive in appearance to this type of material.
 - d. Maintain pressure until the joint cools.
- 6. Allow joint to cool (until finger can remain comfortably on bead) and solidify until bead feels hard. After joint is cool, remove from lineup clamps.
- 7. Inspect finger joint for uniform nonporous appearance. Joints should have uniform double bead/squeezeout to indicate the proper temperature of the heating plate was maintained.
- 8. If joint appears faulty, cut the joint and repeat procedure.
- D. Pipes shall be installed in the locations as shown on the Contract Drawings and provided in these Specifications, using a favorably approved method of control. GROUP'S REPRESENTATIVE has the authority to order the removal or relaying of all pipe laid contrary to the Specifications.
- E. Excavations shall be maintained free of water during the progress of the Work. No pipes shall be laid in water nor shall there be any joints made up in water. All slides or cave-ins of the trenches or cuts shall be remedied to the satisfaction of the GROUP'S REPRESENTATIVE.
- F. Cleanliness of installed pipe and fitting interiors shall be maintained throughout the Work.
- G. All adjustments to the line and grade of pipe shall be done by scraping away or compacted filling of the bedding under the barrel of the pipe, and not by blocking or wedging. The minimum depth of bedding, as shown on the Contract Drawings, shall be maintained at all times.

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- H. Fittings shall be installed as required and in accordance with the Contract Documents. The installation of fittings after the pipeline has been laid will not be permitted without the favorable review of the GROUP'S REPRESENTATIVE.
- I. Favorable review by the GROUP'S REPRESENTATIVE is required prior to changing the location of any of the Work due to field conditions. Changes in pipe sizes are prohibited without prior consent from the GROUP'S REPRESENTATIVE.
- J. All installed piping shall form completely connected systems including connections to and appurtenances specified in other sections to result in a satisfactorily operating installation.
- K. All pipe installed such that, after the line is completed, the interior surface thereof shall conform accurately to the established grade and alignment. No deflections shall be allowed at joints. Piping shall be laid as specified below:
 - 1. Pipe assembly shall be lowered carefully into prepared trench.
 - 2. Line shall not be dropped or subjected to jarring, impact, or unnecessary strain.
 - 3. Sections not carefully lowered in place shall be raised and reinspected. Damaged sections shall be replaced at the sole expense to the CONTRACTOR.
 - 4. Excess stress or strain conditions shall be avoided during installation.
 - 5. Pipe being pulled for placement shall not exceed five-hundred (500) feet in length.
 - 6. Maximum pulling force that can be applied to a pipe can be estimated by multiplying the maximum allowable stress by the cross sectional area of pipe. Pipe shall not be pulled by flanged end.
- L. Minimum pipe lengths of twenty (20) feet (up to maximum pipe lengths of forty (40) feet) shall be utilized, except that shorter random lengths may be utilized where wyes and tees are present so that the connection can be made. The number of pipe joints shall be minimized. CONTRACTOR shall provide proper smooth and square ends prior to assembling.
- M. All below grade pipe shall be buried a minimum of thirty-six (36) inches below finished grades in carefully prepared and backfilled trenches in accordance with Contract Drawings.
- N. Where the header pipe passes beneath roadways and driveways precautions such as a steel protective sleeve or sufficient pipe wall selections shall be taken to protect the pipe from crushing.
- O. Maintain the specified depth and compaction of the embedment materials as shown on the Contract Drawings and as specified below:

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1. Trench/bed width shall be as shown on the Contract Drawings.
2. Unstable trench wall or bottom shall be corrected in accordance with ASTM D2321.
3. Bedding:
 - a. Clean materials surrounding the forcemain pipes shall be free of rock, stones, and other debris that may cut, scrape, tear or rip the HDPE pipe during installation and operation.
 - b. Prior to installation, bedding shall be graded and hand tamped along the entire length of pipe to be installed.
 - c. Bedding material shall be a minimum of 6 inches of sand.
4. Pipe Zone:
 - a. Pipe zone shall be filled with sand as shown on the Contract Drawings.
 - b. Pipe zone includes an area below pipe to 6 inches above the pipe and between pipes and side walls of trench or other pipes.
 - c. Soil in pipe zone may be stabilized with cement-sand mix.
 - d. A minimum of 6-inches of clean material must separate adjacent pipes at all times.
5. Trench backfill shall meet the criteria specified in the Contract Documents and be favorably reviewed by the GROUP'S REPRESENTATIVE.

P. Bends

1. Joints shall not be located in pipe bends.
2. The radius of the inner curve of such bend shall not be less than 25 times the inside diameter of the pipe.

Q. Thrust Blocking:

1. If the HDPE pipe MANUFACTURER's engineering evaluation of soil conditions and design of installation determines thrust blocks are required, then thrust blocks shall be provided at branch connections (tees) and at changes in directions (elbows) as required to prevent movement.
2. Thrust blocking shall be via concrete bearing surfaces set in soil. Pipes shall not be encased in concrete.
3. Details of thrust blocking for each line size shall be furnished by HDPE pipe MANUFACTURER. Details shall be subject to favorable review by the GROUP'S REPRESENTATIVE and the GROUP'S REPRESENTATIVE.
4. Thrust blocks shall not be required if heavy wall fittings (SDR 9) are used for mitre bends 12 inches in diameter and larger.

R. Tests

1. Subsequent to the laying of pipe and placing sufficient backfill between the joints to support and prevent movement of the installation, all newly laid pipe or any valved section thereof shall be subjected to testing, as specified in Section 01666 of the Technical Specifications.
2. All exposed pipe, fittings, valves, and joints shall be carefully examined during the open trench test. Any damaged or defective pipe, fittings or valves revealed during the pressure test shall be removed and replaced, by CONTRACTOR, at his expense, with sound material, in the manner previously specified, and the test shall be repeated until satisfactory to GROUP'S REPRESENTATIVE.
3. The GROUP'S REPRESENTATIVE shall be furnished a written report of the results of the leakage test that identifies the specific length of pipe tested, the pressure, the duration of the test, and the results. The report shall be signed by CONTRACTOR. GROUP'S REPRESENTATIVE will witness all leakage tests.
4. Remedy of Leaks
 - a. If any test of pipe laid discloses leakage, locate and repair (or replace if pipe or fittings are defective) the defective joints until the leakage is within the allowable tolerance.
 - b. All leaks are to be repaired regardless of the amount of leakage.

*****END OF SECTION*****

SECTION 02675

WELL CONSTRUCTION

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. CONTRACTOR shall provide all labor, equipment, materials, tools, and appurtenances required to complete the work of furnishing and installing piezometers, monitoring wells and extraction wells, as shown on the Contract Drawings.
- B. CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations, and laws of local, municipal, State, or Federal authorities having jurisdiction. CONTRACTOR is responsible for identifying and obtaining all appropriate licenses, approvals, and permits to complete the work of this Section. CONTRACTOR shall provide a “Competent Person” to implement, supervise, and inspect the Work.
- C. The term “well” refers to observation wells, monitoring wells, pumping wells, extraction wells, and/or piezometers, unless specifically noted.
- D. Prior to the installation of the specified wells, CONTRACTOR shall identify and perform any necessary utility markouts.
- E. Furnish and install geomembrane pipe boots/sleeves and skirts, in accordance with Section 02590 of these Technical Specifications, for use in areas where the geomembrane cap will be penetrated, as shown on the Contract Drawings or as directed by the REMEDIAL DESIGNER or QUALITY ASSURANCE OFFICER (QAO).
- F. CONTRACTOR and other SUBCONTRACTORS shall coordinate the work of this Section with the work of other Sections, as required. Installation of new piezometers and observation wells shall be completed prior to the installation of the specified new extraction wells, as specified in Section 11110 of these Technical Specifications.
- G. All well installation activities shall be undertaken and performed in accordance with all NJDEP installation procedures as defined in N.J.A.C. 7:9.

1.02 RELATED SECTIONS

- A. 01050 – Field Engineering/Surveying
- B. 01563 – VOC, Odor, Vector and Spill Control
- C. 01564 – Health and Safety
- D. 02221 – Soil and Waste Disposal

- E. 02402 – Liquids Handling and Disposal
- F. 02590 – Geomembranes
- G. 11110 – Pneumatic Leachate Pump System

1.03 GENERAL

- A. The approximate locations and depths of wells are shown on the Contract Drawings. Exact locations will be determined and field verified by the CONTRACTOR and REMEDIAL DESIGNER before the installation of the piezometers/monitoring wells is initiated.

1.04 SUBMITTALS

- A. Drilling methods are described in Part 3 herein. Describe in the Bid Proposal any recommended alternative drilling method(s) based on the reported Site conditions.
- B. Submit a Statement of Qualifications for CONTRACTOR or SUBCONTRACTOR who will perform the installation. Include resumes of drilling crews and the superintendent. Submit safety records (OSHA logs and Experience Modification Ratings for the last 3 years) and insurance rating.
- C. Submit a complete list of all equipment to be used for portions of the Work described in this Section including proposed drill rigs and associated torque capacity. Submit an installation schedule and update it weekly during the Work.
- D. No work shall be performed until the items required by Articles 1.04-A, 1.04-B, and 1.04-C, as specified herein, have been favorably reviewed by the GROUP's REPRESENTATIVE and REMEDIAL DESIGNER.
- E. During drilling of each well, maintain a detailed daily driller's report and submit daily to the QUALITY ASSURANCE OFFICER (QAO). The report shall give a complete description of all formations or material encountered, number of feet drilled, number of hours on the job, shutdowns, feet of casing set, and other pertinent data.
- F. Upon completion of each well, CONTRACTOR shall submit to the GROUP's REPRESENTATIVE and QAO a report including the following:
 - 1. Total depth of the completed well;
 - 2. Depth or location of any lost drilling materials or tools;
 - 3. Nominal hole diameter of the well bore and total depth;
 - 4. Volume and amount of materials (including number of bags) used to fill the annular space;
 - 5. Depth and description of the well casing and screen;
 - 6. Protective casing, plug, cap size, and materials used;
 - 7. Concrete, bentonite, or grout materials used and depths;
 - 8. Number and location of centralizers used;
 - 9. Weather conditions during installation;

10. Name of individual who prepared the report and members of the drilling crew; and
 11. Other pertinent data requested by the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER and QAO.
- G. Following completion of drilling each well, CONTRACTOR shall submit to the QAO signed copies of the driller's log book including the following information:
1. Reference point (e.g., top of casing) for all depth measurements;
 2. Depth at which each change of material occurs;
 3. Identification of the material of which each stratum is composed;
 4. Depth interval from which sample was taken;
 5. Name of individual who prepared log and members of drilling crew;
 6. Water use during drilling;
 7. Penetration resistance during splitspoon sampling (if any);
 8. Water levels encountered during drilling;
 9. Drill rig type, make, and torque capacity;
 10. Split-spoon hammer weight and fall; and,
 11. Other pertinent data requested by the GROUP's REPRESENTATIVE, REMEDIAL DESIGNER and QAO.
- H. CONTRACTOR shall submit well coordinates, top-of-casing elevations, and required survey forms certified by a Land Surveyor licensed and registered in the State of New Jersey, in accordance with N.J.A.C. 7:9.
- I. CONTRACTOR shall supply written certification for the material to be used for the boots, sleeves and skirts, such as that required for the geomembrane under Section 02590 of these Technical Specifications. Certification of these materials may be supplied as part of the requirements of Section 02590 of these Technical Specifications.
- J. CONTRACTOR shall submit product data for the following:
1. Casing pipe;
 2. Well screen;
 3. Drilling fluid materials and additives (if used); and
 4. Mix design of neat cement and cement grout.
- K. CONTRACTOR shall submit a completed NJDEP Well Construction Form for each well constructed. Submit five (5) copies to the GROUP's REPRESENTATIVE and QAO immediately upon completion of each well.
- L. Submit in accordance with Section 01300 of these Technical Specifications.

1.04 QUALIFICATIONS

- A. CONTRACTOR responsible for the construction of the wells shall be properly licensed and employ only competent workmen for the execution of this Work. All such Work shall be performed under the direct supervision of experienced,

licensed well drillers, which are favorably reviewed by the REMEDIAL DESIGNER.

- B. The driller shall be capable of identifying geologic formations, maintaining complete and current well logs and daily notes for the vent completion report.
- C. CONTRACTOR shall provide satisfactory evidence that all materials to be furnished in performing the Work are new and all equipment to be used is in good working order.
- H. All piezometer and well installation activities shall be undertaken and performed in accordance with all NJDEP well installation procedures as defined in N.J.A.C. 7:9.

1.05 HANDLING OF MATERIALS

- A. All parts and materials shall be properly protected so that no damage, deterioration, or contamination will occur from the time of shipment until the Work described in this Section is complete.
- B. If in the opinion of the GROUP's REPRESENTATIVE and/or QAO, parts and materials are damaged, deteriorated, or contaminated, the materials will be rejected and immediately removed from the Site. CONTRACTOR shall replace the parts and materials at CONTRACTOR's own expense.

1.06 SITE CONDITIONS

- A. Coordinate access approvals with the GROUP's REPRESENTATIVE. Notify corporations, companies, individuals or authorities owning conduit wires or pipes running to property or encountered during construction. Protect, support, and maintain conduit, drains, sewers, pipes, and wires.
- B. Do not excavate within influence zone of existing footings or foundations without prior approval of the GROUP's REPRESENTATIVE and REMEDIAL DESIGNER.
- C. Review with and obtain prior approval from the GROUP's REPRESENTATIVE and REMEDIAL DESIGNER for location of mud or water pits or other temporary excavation for construction purposes.
- D. Perform Site grading, filling, and surface stabilization, as necessary, to access the Site with drilling equipment.

1.07 QUALITY ASSURANCE

- A. CONTRACTOR shall perform all testing required and supply any labor and equipment necessary for the testing of the geomembrane cap penetrations.

Coordinate testing with the work of Section 02590 of these Technical Specifications, as required.

PART 2 – PRODUCTS

2.01 GEOMEMBRANE PIPE BOOTS/SLEEVES AND SKIRTS

- A. Pipe boots, sleeves, and skirts shall be constructed out of the same materials used for the specified geomembranes, as specified in Section 02590 of these Technical Specifications.
- B. Geomembrane boots, sleeves, and skirts shall be made by the same manufacturer as the geomembrane for the proposed capping system.

2.02 WELL CASING PIPES

- A. 2-inch I.D. PVC Pipe: Schedule 40 with flush threaded joints and “O” rings.

2.03 GROUT

- A. Neat Cement:
 - 1. Cement and water in proportion of one (1) bag (94 lb) Portland cement to 8.3 gal clean water. Slurry weight of 13.4 to 14.5 lbs-per-gallon. A mud balance shall be used to verify slurry weight.
 - 2. Mix design, method of mixing, and consistency of grout shall be approved by the REMEDIAL DESIGNER.
 - 3. Cement grout admixtures may be used to increase fluidity, reduce shrinkage or control time of set. Use of admixtures shall be approved by the REMEDIAL DESIGNER, as appropriate.
 - a. No more than five (5) lbs of bentonite may be added per bag (94 lb) of cement.

2.04 WELL SCREENS

- A. Manufacturers:
 - 1. Howard Smith Screen Company.
 - 2. Johnson Screen Company.
 - 3. Or approved equal.
- B. Schedule 40 PVC, pipe size, having minimum inside diameter of 2 inches.
- C. Estimated screen slot size: 0.010 inch, to be verified by the QAO during construction.
- D. Close bottom with threaded plug of same material as the screen.

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- E. All fittings shall be flush threaded with “O” rings.

2.05 FILTER PACKS

- A. Manufacturers:
 - 1. Morie Company, Inc.
 - 2. Or approved equal.
- B. Clean, washed, acid-resistant, well-rounded, graded flint/quartz type grains. Free of foreign/deleterious materials.
- C. Size determined by the REMEDIAL DESIGNER.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Inspect all materials upon delivery and before placement to document that they are in the original packaging as supplied by the manufacturer or supplier and free of any material that may alter the chemical quality of the vent.

3.02 PREPARATION

- A. Protect existing structures from damage.
- B. Prepare the area for staging of drill cuttings prior to relocation to designated areas on the Site in accordance with Section 02221 of these Technical Specifications.
- C. CONTRACTOR shall provide access to all wells. Proposed access locations shall be reviewed with the GROUP's REPRESENTATIVE and REMEDIAL DESIGNER.

3.03 GENERAL

- A. Details of proposed wells are included in the Contract Drawings for reference purposes, and shall not be interpreted to indicate exact formation, thickness, and material encountered. This information will be verified during construction.
- B. All well installation activities shall be undertaken and performed in accordance with all NJDEP procedures, as defined by N.J.A.C. 7:9.
- C. Use of mud rotary drilling techniques is not recommended, as overly excessive amounts of mud may be needed. Drilling methods shall be approved by the REMEDIAL DESIGNER, and shall be in accordance with all state and local standards for well construction.
 - 1. Acceptable drilling fluids are driller's mud, potable water and air.

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2. Piezometers/monitoring wells shall be drilled straight and plumb.

- D. Collect representative soil samples and perform sieve analyses to confirm screen slot size, as necessary. Submit results of the analyses to the REMEDIAL DESIGNER.
- E. CONTRACTOR shall provide clean, potable water for drilling and grouting.

3.04 WELL CONSTRUCTION

- A. Drill a minimum 6-inch diameter borehole.
- B. Following construction of the 6-inch diameter borehole, install a 2-inch diameter pipe in the open hole. Screen lengths shall be ten (10) feet.
- C. Terminate upper-end of casing at height or depth relative to ground surface indicated on the Contract Drawings.
- D. After placement of screen and casing, fill annular space outside of screen with filter pack material to a depth of one (1) foot above top of screen.
- E. Place a 2-foot-thick fine sand seal in the annular space between the 2-inch I.D. casing and the native formation directly above the filter pack, to prevent migration of grout into the filter pack.
- F. Fill the annular space between 2-inch I.D. casing and the native formation above the fine sand seal with neat cement grout. Notify the REMEDIAL DESIGNER and QAO at least twenty-four (24) hours before grouting wells.
- G. Grout by placing tremie pipe with “tee” fitting on the lower end to within one (1) foot of fine sand seal. Grout continuously to ensure entire filling of annular space in one operation. Force grout down tremie pipe under moderate pressure with grout pump and force upward into annular space between casing and surrounding formation. Slowly remove grout tremie pipe as grouting operation progresses with bottom of pipe submerged in grout. Terminate the grout at the depth shown on the Contract Drawings.
- H. After completion of well, and after the grout has set for minimum of twelve (12) hours, develop the wells by air-lift and/or submersible pumping in accordance with Article 3.05.
- I. Conduct a short-duration performance test to verify performance.

3.05 EXTRACTION WELL DEVELOPMENT

- A. Perform development of all designated new extraction wells by air-lift and/or submersible pumping after completion of the well construction.

- B. Prior to development, clean out any fill from well.
- C. Provide necessary appurtenances for performing well development.
- D. Provide discharge tee or other apparatus to control water removed from well. Pack around tee and air line to prevent water spray.
- E. Provide an air compressor equipped with an oil trap for air-lift surging, if used, that is capable of providing continuous flow of air to pump continuously from well and place air line pipe in well to adequate submergence to properly develop well. Pump well using air-lift method, if used, until water is clear and relatively free of sand. Surge well by alternately discharging compressed air.
- F. Continue development until turbidity, temperature, pH, dissolved oxygen, and specific conductance of pumped water have changed by 10% or less over three (3) consecutive readings, spaced ten (10) minutes apart; or until development is satisfactory to the QAO and REMEDIAL DESIGNER.
- G. Collect, handle and dispose of well development water in accordance with Article 3.06 herein and Section 02402 of these Technical Specifications.

3.06 DECONTAMINATION

- A. The drill rig and all drilling equipment shall be steam-cleaned upon arrival on-Site and prior to leaving the Site. Steam cleaning shall also be conducted following installation of wells. Potable water for steam cleaning shall be supplied by the CONTRACTOR. Between boreholes, all soil and wastes shall be removed from the drill rig and drilling equipment at the borehole location. Drill cuttings and other solid materials shall be disposed of in accordance with Section 02221 of these Technical Specifications.

3.07 LIQUIDS HANDLING

- A. All aqueous and non-aqueous liquids used, collected or encountered during the performance of this Work, including well development water and decontamination water, shall be collected and handled in accordance with Section 02402 of these Specifications.

3.08 WELL PROTECTION

- A. During the progress of the Work, the CONTRACTOR shall protect all wells from tampering or the entrance of foreign material.

*****END OF SECTION*****

SECTION 02831

CHAIN-LINK FENCES AND GATES

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. CONTRACTOR shall furnish all labor, materials, equipment and appurtenances required for the installation of complete chain-link fence systems. Fencing and gates shall be installed in the locations shown on the Contract Drawings, and/or as otherwise required by CONTRACTOR and favorably reviewed by the REMEDIAL DESIGNER.
- B. CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations, and laws of local, State, or Federal authorities having jurisdiction. CONTRACTOR is responsible for identifying and obtaining all appropriate licenses, approvals, and permits to complete the Work of this Section. CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect the Work.

1.02 SUBMITTALS

- A. Shop Drawings
 - 1. CONTRACTOR shall submit to the GROUP's REPRESENTATIVE, QUALITY ASSURANCE OFFICER (QAO), and REMEDIAL DESIGNER, at least twenty-one (21) calendar days prior to construction, catalog cuts, manufacturer's installation instructions, and dimensioned drawings for fencing, gates, and associated details for installation.
 - 2. Submit detailed layout drawing showing the location of each fence post, including connection details for securing the fence posts to the back side of the installed new steel sheet pile wall.
- B. Submit in accordance with Section 01300 of these Technical Specifications.

1.03 DELIVERY AND HANDLING

- A. Deliver materials with the manufacturer's tags and labels intact.
- B. Handle and store materials in such a manner that will avoid damage.

1.04 QUALITY ASSURANCE

- A. Comply with the standards of the Chain-Link Manufacturers Institute and these Technical Specifications.

- B. Provide fencing as a complete unit produced by a single manufacturer including the required erection accessories, fittings, and fasteners.

1.05 CODES AND STANDARDS

The latest editions of the publications listed below are included as a part of these Specifications.

- A. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
 - A123/A123M Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - A153/A153M Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - A392 Zinc-Coated Steel Chain-Link Fence Fabric
 - A641/A641M, Zinc-Coated (Galvanized) Carbon Steel Wire

PART 2 – PRODUCTS

2.01 GENERAL

- A. The height for all new fencing shall be six (6) feet. Posts shall be set at no more than 10-foot-centers. Along the east, west and south Site perimeters, fence posts shall be installed with concrete footings, poured to the full size of the excavated post holes. Along the north Site perimeter, the fence posts shall be securely fixed (by either bolted or welded connections, to the tops of the installed new steel sheet pile wall, and CONTACTOR shall develop and submit details for securing said fence posts to the new steel sheet pile wall. Corner posts shall have the necessary strut and tie bracing. Gates shall be provided at the locations and with the sized indicated on the Contract Drawings, or as directed by the REMEDIAL DESIGNER.
- B. Where temporary fencing crosses ditches, steep grades, and other unusual conditions, make special provisions to insure that the security, appearance, maintainability and permanence of the standard fencing are maintained.

2.02 MATERIALS AND CONSTRUCTION

- A. Fence Mesh and General Note: Nine (9) gauge wire, woven to 2-inch-squares, zinc-coated (hot-dip galvanized), galvanized after weaving, 6-foot-wide rolls. Continuous tension wire shall be provided at the lower and upper edges of the

mesh. Fence mesh shall be of one continuous piece from top to bottom and between posts. Zinc-coated fabric shall conform to ASTM A392, Class 2.

- B. Line Post: 2-1/2-inch outside diameter (OD) ASTM A53 standard weight Galvanized Pipe (3.65 lbs/ft.), or approved equivalent.
- C. Corner Post: 3-inch OD ASTM A53 standard weight Galvanized Pipe (5.79 lbs/ft.), or approved equivalent.
- D. Gate Post: 4-inch OD ASTM A53 standard weight Galvanized Pipe (9.11 lbs/ft.), or approved equivalent.
- E. Top Rail: 1-5/8-inch OD ASTM A53 standard weight Galvanized Pipe (2.27 lbs/ft.) with extra long pressed steel sleeves, or approved equivalent.
- F. Tension Wire: No. 7 gauge steel spring coil tension wire, zinc-coated (hot-dip galvanized). Zinc-coated wire shall conform to ASTM A641, Class 3, or approved equivalent.
- G. Swing Gates:
 - 1. Frame shall be 2-inch OD ASTM A53 standard weight galvanized pipe with galvanized pressed steel or galvanized malleable iron corner ells riveted or bolted at corners, or approved equivalent.
 - 2. Internal bracing shall be NPS 1 ASTM A53 standard weight galvanized pipe with 3/8-inch diameter galvanized adjustable truss rods and truss fasteners, or approved equivalent.
 - 3. Bottom hinge shall be galvanized malleable iron pivot type, or approved equivalent.
 - 4. Top hinge shall allow gate to swing 90° to 180°.
 - 5. Gate shall be complete with padlocking device, center rest, and semi-automatic catch to secure gate in open position.
 - 6. Gates shall be provided to match fence height and with the following minimum widths:
 - a. Person Gates: Provide a single gate of 3-foot-width.
 - b. Vehicular Gates: Provide dual gates of equal width to provide an overall gate width of sixteen (16) feet.
- H. Hardware, fasteners, and accessories: galvanized and compatible with other fence system components.
- I. Brace rail: ASTM A53 standard weight galvanized pipe with 3/8-inch-diameter galvanized steel truss rods and truss tighteners, or approved equivalent.
- J. Lifting Eyes: Provide at each end of removable panels of adequate strength and attachment to allow fence panel removal. Provide galvanized steel or stainless

steel, or approved equivalent. Repair damage to galvanized surfaces with Galv-Alloy or other means.

K. Extension Arms (where required):

1. Line Post arms shall be fabricated of pressed steel or malleable iron base with pressed steel extension riveted on, or approved equivalent.
2. Corner Posts arms shall be fabricated of 11-gauge (minimum) pressed steel or heavy malleable iron base with 11-gauge (minimum) pressed steel extension riveted on, or approved equivalent.
3. Arms shall be galvanized in accordance with ASTM A123, or approved equivalent.
4. Arms shall be able to withstand a minimum pull down weight of three-hundred (300) pounds and of the barbed wire stretched to proper tension.
5. Arms shall be securely fastened to post.

L. Tension Bars and Bands: Tension bars for pulling fence fabric to terminal posts shall be 3/4-inch steel bars, hot-dip galvanized in accordance with ASTM A123, or approved equivalent. Bands for fastening tension bars to terminal posts shall be eleven (11) gauge by 1-inch-wide steel; hot-dip galvanized in accordance with ASTM A123, or approved equivalent.

M. Barbed Wire: Provide galvanized barbed wire with barbs spaced not more than ten (10) inches apart, or approved equivalent.

N. Concrete: Concrete for setting of fence posts shall have a minimum 28-day compressive strength of three-thousand (3000) psi.

PART 3 – EXECUTION

3.01 GENERAL

- A. Fences shall be installed to the lines and grades indicated in the Contract Documents, or as directed by the REMEDIAL DESIGNER. The area on either side of the fence line shall be cleared to the extent required for proper installation. Line post shall be spaced equidistant at intervals not exceeding ten (10) feet. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts, however, runs between terminal posts shall not exceed five-hundred (500) feet.

3.02 POSTS

- A. Posts shall be set plumb and in alignment. Except where solid rock is encountered, posts shall be set in concrete to the depth of thirty-six (36) inches. Where solid rock is encountered with no overburden, posts shall be set to a minimum depth of eighteen (18) inches in rock. Where solid rock is covered with an overburden of soil or loose rock, posts shall be set to a minimum depth of thirty-six (36) inches

unless a penetration of eighteen (18) inches in solid rock is achieved before reaching the 36-inch depth in which case depth of penetration shall terminate. All portions of posts set in rock shall be grouted. Portions of posts not set in rock shall be set in concrete from the rock to ground level. Posts set in concrete shall be set in holes not less than twelve (12) inches in diameter for terminal post and nine (9) inches in diameter for line posts. Diameters of holes in solid rock shall be at least one (1) inch greater than the largest cross section of the post. Concrete and grout shall be thoroughly consolidated around each post so as to be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for a minimum of thirty-six (36) hours prior to attachment of any item to the posts.

3.03 BRACES AND TRUSS RODS

- A. Braces and truss rods shall be installed as required and in conformance with the standard practice for the fence furnished. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately forty (40) to fifty (50) degrees with the horizontal.

3.04 TENSION WIRES

- A. Tension wires shall be installed along the bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top rails shall be installed as shown on the drawings. Bottom tension wire shall be installed within the bottom six (6) inches of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

3.05 CHAIN-LINK FABRIC

- A. Chain-link fabric shall be installed on the side of the post indicated. Install fabric on the Site side of the posts if side is not indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 15-inch intervals. Fabric shall be pulled taut to provide a smooth uniform appearance free from sag. Fabric shall be fastened to line posts at approximately 15-inch intervals and fastened to tension wires at approximately 24-inch intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be two (2) inches (plus or minus ½-inch) above the ground.

3.06 BARBED WIRE SUPPORTING ARMS AND BARBED WIRE

- A. Barbed wire supporting arms and barbed wire shall be installed as indicated in the Contract Documents similar to the existing fence and as recommended by the Manufacturer. Barbed wire shall be pulled taut and attached to the arms with clips or other means that will prevent easy removal.

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3.07 GATES

- A. Gates shall be installed at the locations shown in the Contract Documents, or as directed by the REMEDIAL DESIGNER. Hinged gates shall be mounted to swing as indicated in the Contract Documents. Latches, stops, and keepers shall be installed as required in the Contract Documents. Padlocks shall be attached to gates or gate posts with chains to prevent padlock removal.

3.08 GROUNDING

- A. Fences crossed by power lines of six-hundred (600) volts or more shall be grounded at or near the point of crossing and at distances not exceeding one-hundred-fifty (150) feet on each side of crossing. Ground conductor shall consist of No. 8 AWG solid copper wire. Grounding electrodes shall be ¾-inch by 10-foot long copper-clad steel rod. Electrodes shall be driven into the earth so that the top of the electrode is at least six (6) inches below the grade. Where driving is impracticable electrodes shall be buried a minimum of twelve (12) inches deep and radial from the fence. Top of electrode shall be not less than two (2) feet, nor more than eight (8) feet from the fence. Ground conductor shall be clamped to the fence and electrodes with bronze grounding clamps so as to create electrical continuity between fence posts, fence fabric, and ground rods. After installation the total resistance of fence to ground shall not be greater than twenty-five (25) ohms.

3.09 REMOVAL OF EXISTING CHAIN-LINK SECURITY FENCE

- A. The designated portions of the existing chain-link security fence as identified on the Contract Drawings shall be removed in a workmanlike manner to preclude unnecessary damage to the fence and gate materials. Except for tie wires, fabric bands, lock wires, and concrete foundations, all fence materials to be removed shall be salvaged to the extent possible for reinstallation. All tie wires, fabric bands, lock wires and any other existing fence materials removed and not reinstalled shall be disposed of by the CONTRACTOR off the project site. The existing posts shall be cutoff at ground level. Post excavation shall be filled with suitable material in 6-inch layers and compacted to at least the density of the adjacent ground, except in areas where excavation is required after the removal of the fencing where the post excavation shall be filled only to the elevation of the finished grade.

3.10 REUSE OF EXISTING CHAIN-LINK FENCE

- A. The removal of existing fence shall be in accordance with the requirements herein before specified. All fence materials shall be disposed off-site at a permitted municipal solid waste landfill. If the condition of the fabric is adequate to allow re-use of the material, the CONTRACTOR shall notify the GROUP's REPRESENTATIVE and QAO of his intention to re-use fabric, stipulating the portions to be re-used. This material may be re-used with the approval of the QAO and/or GROUP's REPRESENTATIVE. The CONTRACTOR shall indicate to the

GROUP's REPRESENTATIVE the cost savings that can be realized by re-using the fabric, with his request of such.

- B. Vegetative matter shall be removed from fence fabric prior to reuse. All tie wires, fabric bands, lock wires, and concrete foundations used to install the fence shall be new (i.e. not re-used). The CONTRACTOR shall supply such new parts conforming to the requirements of this section as are necessary to complete the installation of the relocated fence.
- C. Any fence materials to be reused which are damaged by the CONTRACTOR shall be repaired or replaced with new materials at no additional cost to the GROUP.

3.11 CLEANING

- A. Perform cleaning during installation of the Work and upon completion of the Work. Remove from the Site all fence debris and equipment. Repair all damage resulting from the installation of the chain-link fence system as directed by the GROUP's REPRESENTATIVE or QAO, at the CONTRACTOR's sole expense.

3.12 EXISTING FENCE TO REMAIN

- A. All chain link fencing designated to remain in place shall be jointly inspected by the CONTRACTOR and the QAO prior to the start of any work, and an agreement shall be signed briefly setting forth the current condition thereof. The CONTRACTOR shall repair / replace components of the existing fence to meet the requirements of the above specifications.

*****END OF SECTION*****

SECTION 02936

SEEDING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall furnish all labor, materials, equipment, tools, and appurtenances required to complete the seeding of all areas disturbed, regraded or disturbed during the performance of the Work, including seed, mulch, temporary protection and watering, as required, during the course of construction.
- B. The CONTRACTOR shall comply with all applicable codes, ordinances, rules, regulations and laws of local, State, or Federal authorities having jurisdiction. The CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect the work.

1.02 RELATED SECTIONS

- A. 02125 – Erosion and Sediment Control
- B. 02225 – Vegetative Support Layer

1.03 SUBMITTALS

- A. A manufacturer's Certificate of Compliance for the seed mixture shall be submitted to the QUALITY ASSURANCE OFFICER (QAO) by the supplied manufacturer with each shipment of each type of seed. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed, net weight, and the date of shipment. No seed may be sown until the CONTRACTOR has submitted these certificates and they have been favorably reviewed by the QAO.
- B. The CONTRACTOR shall provide analysis of soil suitability to sustain vegetation. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value by performing Baker or LaMotte Test.
- C. Submit in accordance with Section 01300 of these Technical Specifications.

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1.04 QUALITY ASSURANCE

- A. A satisfactory stand of grass, as determined by the QAO, shall be required after seeding. To be acceptable, bare spots shall be scattered, there shall be no bare spots larger than one (1) square-yard, and the stand of grass shall consist of a uniform stand of at least seventy (75) percent established permanent grass species within sixty (60) calendar days of initial seeding and maintaining that stand of grass for one year after initial seeding.
- B. Maintain erosion and sediment controls in accordance with Section 02125 of these Technical Specifications.

1.05 DEFINITIONS

- A. Weeds include, but are not limited to, Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Broome Grass.

1.06 QUALITY CONTROL

- A. The CONTRACTOR shall submit to the REMEDIAL DESIGNER evidence of compliance with the testing specified herein and with the referenced Technical Specification section, as identified under Article 1.02 herein, at least seven (7) calendar days prior to placement.

PART 2 - PRODUCTS

2.01 SEED MIXTURE FOR PERMANENT COVER

- A. The following seed mixture shall be used for permanent cover:

<u>Common Name</u>	<u>Application Rate</u> <u>(lbs per acre)</u>
Hard Fescue	120 lbs/acre
Creeping Fescue	30 lbs/acre
Perennial Ryegrass	10 lbs/acre

Labels and contents shall conform to all State and Federal regulations. Seed shall be subject to the testing provision of the Association of Official Seed Analysts.

- B. The specified application rates are minimum values. The CONTRACTOR may elect to apply the specified seed mixtures more densely in order to meet the requirements of Article 1.03-A herein.

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- C. The REMEDIAL DESIGNER, reserves the right to change the seed mixture and recommended seeding dates, based upon the time of year in which the construction is performed (i.e., winter rye).

2.02 SEED MIXTURE FOR TEMPORARY COVER

- A. The following seed mixture shall be used for temporary cover:

<u>Common Name</u>	<u>Application Rate (lbs per acre)</u>
Annual Ryegrass	40 lbs/acre
Perennial Ryegrass	40 lbs/acre

Labels and contents shall conform to all State and Federal regulations. Seed shall be subject to the testing provision of the Association of Official Seed Analysts

- B. The specified application rates are minimum values. The CONTRACTOR may elect to apply the specified seed mixtures more densely in order to meet the requirements of Article 1.03-A herein.
- C. The REMEDIAL DESIGNER, reserves the right to change the seed mixture and recommended seeding dates based upon the time of year in which the construction is performed (i.e., winter rye).

2.03 FERTILIZER

- A. 10-20-10 fertilizer, or approved equivalent, shall be applied at a rate of six-hundred (600) pounds-per-acre (lbs/acre), unless fertility testing indicates that another fertilizer and/or a different application rate is appropriate.

2.04 MULCH

- A. Straw mulch shall be oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable. Straw mulch shall be properly anchored.
- B. Wood fiber mulch shall consist of wood fiber produced from clean, whole uncooked wood, formed into resilient bundles having a high degree of internal friction and shall be dry when delivered to the Site.

2.05 WATER

- A. Water shall be clean, fresh, potable, and free of substances or matter that could inhibit vigorous growth of grass.

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2.06 LIME

- A. Agricultural grade lime shall be applied at a rate indicated by fertility testing.

PART 3 - EXECUTION

3.01 INSPECTION

- A. CONTRACTOR shall verify that prepared soil bases are ready to receive the work of this Section.
- B. CONTRACTOR shall inspect seedbed immediately prior to seeding. If traffic has left the soil compacted, the area must be retilled.

3.02 DELIVERY, STORAGE, AND HANDLING

- A. The CONTRACTOR shall deliver grass seed mixture in sealed containers showing weight, seed mix, year of production, date of packaging, and location of packaging. Seed in damaged packaging shall not be acceptable.
- B. The CONTRACTOR shall deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer. Fertilizer in damaged packaging is not acceptable.

3.03 LIMING

- A. When required, ground limestone that has been protected from moisture, and is dry and free flowing, shall be evenly spread over the area to be seeded at a rate that will produce a pH value of the soil of 6.5.
- B. The CONTRACTOR shall work lime into vegetative layer to a depth of four (4) inches with a disc, spring-tooth harrow, or other suitable equipment.

3.04 FERTILIZING

- A. The CONTRACTOR shall apply fertilizer in accordance with manufacturer's instructions.
- B. The CONTRACTOR shall apply fertilizer after grading of the vegetative support layer.
- C. The CONTRACTOR shall not apply fertilizer at the same time or with the same machine as that will be used to apply seed unless hydroseeding.

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- D. The CONTRACTOR shall mix fertilizer thoroughly into upper four (4) inches of the vegetative layer with a disc, spring-tooth harrow, or other suitable equipment.
- E. The CONTRACTOR shall lightly water ground surface to aid the dissipation of fertilizer.

3.05 HYDROSEEDING

- A. All seed will be placed by Hydroseeding. When applying seeds, lime, fertilizer, or mulch materials with the hydroseeder, do not use more than one-hundred (100) to one-hundred-fifty (150) pounds of solids per one-hundred (100) gallons of water. If inoculate is in a seed, fertilizer, and lime slurry, it shall be used within three to four hours, or a fresh supply of inoculate shall be added. Hydroseed shall be applied to moist soil.
- B. The CONTRACTOR shall apply seed at the rates the shown in Articles 2.01 and 2.02 of this Section, or as recommended by local USDA Soil Conservation Service office.
- C. Planting season shall be as recommended by the Soil Conservation District.
- D. The CONTRACTOR shall not sow immediately following rain, when ground is too dry, frozen, or during windy periods.

3.06 MULCHING

- A. Straw mulch shall be applied at a rate of two (2) tons-per-acre.
- B. Wood fiber mulch shall be applied to seeded area at a rate of one-thousand-five-hundred (1,500) pounds-per-acre. Immediately before spraying, the mulching material shall be mixed with water in the sprayer and kept uniformly suspended in the water by agitation during the spraying operation.

3.07 WATERING

- A. The plants shall be watered as necessary to maintain an adequate supply of moisture within the root zone. An adequate supply of moisture is estimated to be the equivalent of one inch of absorbed water per week delivered in the form of natural rain or augmented as required by periodic waterings. Run-off, puddling and wilting shall be prevented.
- B. Water: Plants shall be watered as necessary for up to one-year after initial seeding to maintain an adequate supply of moisture within the root zone. Run-off, puddling and wilting shall be prevented.
- C. Water shall not contain elements toxic to plant life.

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3.08 RESEEDING

- A. Where vegetative coverage is less than seventy-five (75) percent within sixty (60) calendar days and one (1) year of initial seeding, the CONTRACTOR shall place additional seed in accordance with Articles 3.05 herein, at no additional cost to the GROUP.

*****END OF SECTION*****

SECTION 03100

CONCRETE FORMWORK

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall furnish and install concrete formwork, as required and necessary, to construct pumping well vaults, fence posts, and as shown and indicated on the Contract Drawings, as specified in this Section, as directed by the REMEDIAL DESIGNER, and as otherwise required to complete the Work.
- B. The CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations and laws of local, municipal, state or Federal authorities having jurisdiction. The CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect all Work.

1.02 RELATED SECTIONS

- A. 01050 – Field Engineering/Surveying
- B. 03200 – Concrete Reinforcement
- C. 03300 – Cast-in-Place Concrete
- D. 03400 – Precast Concrete
- E. 03800 – Mass Concrete

1.03 RELATED REFERENCES

The latest editions of the publications listed below are included as a part of these Technical Specifications.

- A. ACI 318 Building Code Requirements for Reinforced Concrete
- B. ACI 347 Recommended Practice for Concrete Formwork
- C. PS 1 US Department of Commerce Product Standard (PS)
Construction and Industrial Plywood

1.04 FORM DESIGN

- A. The design of forms and their performance, as required by this Section, is the CONTRACTOR's responsibility. Formwork shall comply with ANSI A10.9 and OSHA Construction Standards, Part 1926, Subpart Q, Concrete, Concrete Forms, and Shoring.

PART 2 – PRODUCTS

2.01 FORM MATERIAL

- A. Formwork for all concrete, unless otherwise specified, shall not be less than 5/8-inch, 5-ply Douglas fir plywood of exterior structural grade especially processed to resist moisture and conforming to PS 1, B-B Concrete Form Panels. Patented forms may be used, subject to approval by the GROUP'S REPRESENTATIVE

and QUALITY ASSURANCE OFFICER (QAO), provided they are in new, or like-new condition so as to produce a smooth, even surface free from blemishes, defects, and depressions; this approval is for the finish these forms will leave on the contact surfaces and will not relieve the CONTRACTOR of the responsibility for the design and structural soundness of the forms.

2.02 ACCESSORIES

- A. Form tie assemblies shall be form clamps with smooth tie rods, with a waterstop at the center, permitting tightening of the forms and be of such type as to leave no metal or other material within 1-1/2-inch of the surface after use. The assembly should provide cone-shaped depressions in the cast surface at least 1-inch-diameter and 1-1/2-inch-deep to allow filling and patching.
- B. Form releasing agent shall be a non-staining form coating compound such as "Cast-Off" by Sonneborn Products Division (Contech, Inc.), or an equal product as approved by the GROUP'S REPRESENTATIVE.

PART 3 – EXECUTION

3.01 FORM CONSTRUCTION

- A. Formwork shall be in accordance with ACI 347 and as follows:
 - 1. Forms shall conform to shapes, lines, and dimensions of members required and shall be sufficiently rigid and tight to prevent leakage of the cement binder. Forms shall be properly braced or tied together so as to maintain position and shape. Construct forms so that they can be removed readily without hammering or prying against the concrete. Forms for exposed concrete shall be carefully made and accurately placed to obtain correct shape and lines.
 - 2. Joints shall be butted tight on solid bearings. Arrangements of panels shall be orderly and symmetrical, and use of small pieces shall be avoided. Forms shall be chamfered for external corners of concrete, including top of walls, which will be exposed in the finished work.
 - 3. The CONTRACTOR shall be fully responsible for the adequacy of formwork in its entirety. Forms shall support the anticipated loading while maintaining their dimensional and surface correctness to produce members with the required geometry.
 - 4. Block-outs for slots, chases, recesses or other openings shall be provided by the CONTRACTOR as needed by the work of this and any other trades.
 - 5. Install all the inserts to be supported by the formwork as required by the work of this and other trades as needed.

3.02 TOLERANCE FOR FORMED SURFACES

- A. Variation from Plumb: Not more than $\pm 1/4$ inch in any ten (10) feet of length with a maximum for the entire length of $\pm 1/2$ inch.

- B. Variation from the Level or from the Grades Specified in the Contract Drawings: Not more than $\pm 1/4$ inch in any ten (10) feet of length with a maximum for the entire length of $\pm 3/4$ inch.
- C. Variation in the Sizes and Location of Openings and Thickness of Walls: $\pm 1/4$ -inch.

3.03 INSPECTION

- A. CONTRACTOR shall give the GROUP'S REPRESENTATIVE and QAO at least forty-eight (48) hours notice before any concrete is to be cast. Concrete shall not be cast until the GROUP'S REPRESENTATIVE and QAO have observed and given approval of the Work to be cast including, but not limited to, the placement of all the reinforcing, accessories, forms and the surfaces to be cast against. Such observations are in the nature of assisting the CONTRACTOR to minimize errors and in no case will they serve to relieve the CONTRACTOR of the responsibility to provide the materials and workmanship required by the Contract Documents.

3.04 APPLICATION OF FORM COATING

- A. Immediately before the placing of reinforcing, faces of all forms in contact with the concrete shall receive a thorough coating of the liquid form-releasing agent specified, applied in compliance with the Manufacturer's instructions.

3.05 REMOVAL OF FORMS

- A. The CONTRACTOR shall assume full responsibility for removal of formwork and forms shall be removed in such a manner as to insure complete integrity and safety of the structure. Forms and shoring for mass concrete, walls, columns, and beams shall remain in place a minimum period of seven (7) days after casting the concrete. Forms for slabs shall remain in-place a minimum of twenty-four (24) hours after casting.
- B. Wood forms shall be completely removed from all concrete cast to avoid termite infestation.

3.06 SURVEYING

- A. Prior to pouring concrete, accurately survey and measure the size and location of all structures to be placed in the concrete. Survey and record measurements in accordance with Section 01050 of these Technical Specifications.
- B. Provide drawings showing surveyed measurements, dimensions, and locations necessary to locate accurately anchors, pipes, tanks, conduit, and other structures buried in or below concrete.

*****END OF SECTION*****

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall size, furnish, and install concrete reinforcement for the pumping well vaults, and as shown and indicated on the Contract Drawings, as specified in this Section, as directed by the REMEDIAL DESIGNER, and as otherwise required to complete the Work.
- B. The CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations and laws of local, municipal, state, or Federal authorities having jurisdiction. The CONTRACTOR shall provide a "Competent Person" to implement, supervise, and inspect all Work.

1.02 RELATED SECTIONS

- A. 03100 – Concrete Formwork
- B. 03300 – Cast-in-Place Concrete
- C. 03400 – Precast Concrete

1.03 REFERENCED PUBLICATIONS

The latest edition of the publications listed below are included as part of these Specifications.

- A. ACI 318 Building Code Requirements for Reinforced Concrete
- B. ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures
- C. ASTM A82 Specification for Cold Drawn Steel Wire for Concrete Reinforcement
- D. ASTM A185 Specification for Welded Steel Wire Fabric for Concrete Reinforcement
- E. ASTM A496 Deformed Steel Wire for Concrete Reinforcement
- F. ASTM A497 Welded Deformed Steel Wire Fabric for Concrete Reinforcement
- G. ASTM A615 Specification for Deformed and Billet-Steel Bars for Concrete Reinforcement

1.04 SUBMITTALS

- A. Shop Drawings: Reproductions of drawings contained in the Contract Documents are not permitted. Shop Drawings shall show the required bar sizes, spacing, and splice length for all reinforcement; reinforcement placing plans; and, bending details and complete bar lists. All relevant details and notes appearing on the Contract Drawings shall be shown on the Shop Drawings. Shop Drawings will not be reviewed without such information. Reinforcement shall be shown in plan and cross-section, with wall reinforcing shown in elevation. Location and arrangement of accessories and block-outs shall be clearly indicated. Placing drawings, detail drawings and bar lists shall be checked by the MANUFACTURER and the CONTRACTOR before being submitted to the GROUP'S REPRESENTATIVE.
- B. Mill tests of reinforcing steel shall be submitted prior to use for each fifteen (15) tons or less shipped to the Site. Tests shall be conducted in conformance with ASTM A615, and methods prescribed therein.
 - 1. Cost of testing shall be borne by the CONTRACTOR.
 - 2. Three (3) copies of each test report stating whether the material meets the requirements of the ASTM specifications shall be submitted to the GROUP'S REPRESENTATIVE and the QUALITY ASSURANCE OFFICER (QAO).
 - 3. Certified copies of the mill tests may be considered evidence of compliance provided such tests are regularly conducted by the reinforcement MANUFACTURER by experienced, competent personnel using appropriate testing equipment. In case of doubt as to the adequacy or accuracy of the mill tests, the QAO may require the CONTRACTOR to furnish, at the GROUP's expense, test results from an independent testing laboratory acceptable to the GROUP'S REPRESENTATIVE on mill samples or delivered steel reinforcement.
- C. Submit in accordance with Section 01300 of these Technical Specifications.

PART 2 – PRODUCTS

2.01 REINFORCING BARS

- A. Bar reinforcement shall be deformed-type bars conforming to ASTM A615. Reinforcement shall be manufactured from new billet steel of American manufacture, Grade 60, yield strength 60,000 psi (min.).

2.02 WELDED WIRE FABRIC

- A. Welded wire fabric shall be in flat sheets conforming to ASTM A185 (A497), with wire conforming to ASTM A82 (A496).

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2.03 ACCESSORIES

- A. All chairs and bolsters shall have plastic-covered or galvanized steel legs.
- B. For slabs on grade, all reinforcing shall be supported on chairs and/or bolsters as required to properly position the bars. The chairs and/or bolsters shall be supported on precast concrete bricks bearing on the subgrade. The concrete supports shall be at least 6-inch by 4-inch and no more than 1 inch thick. Pads shall be cast from Class "A" concrete or from mortar made up of one part cement and two parts sand, with embedded tie wires.

PART 3 – EXECUTION

3.01 STORAGE OF MATERIALS

- A. Reinforcing steel delivered to the Site, not immediately placed in forms, shall be protected from mud and excessive rust-producing conditions by storing in a well-drained area and supported off the ground.

3.02 INSPECTION OF STEEL PLACEMENT

- A. The CONTRACTOR shall give the GROUP'S REPRESENTATIVE and QAO at least forty-eight (48) hours notice before any concrete is to be cast. Concrete shall not be cast until the GROUP'S REPRESENTATIVE and QAO have observed and given approval of the work to be cast including, but not limited to, the placement of all the reinforcing, accessories, forms and the surfaces to be cast against. Such observations are in the nature of assisting the CONTRACTOR to minimize errors and in no case will they serve to relieve the CONTRACTOR of the responsibility to provide the materials and workmanship required by the Contract Documents.

3.03 TOLERANCES

- A. Allowable tolerances for fabricating steel reinforcement shall be as follows:

Item	Maximum Tolerance
Sheared length of bars	± 1-inch
Location of bends	± 1-inch

- B. Allowable tolerances for placing steel reinforcement shall be as follows:

Item	Maximum Tolerance
Concrete cover from outside of bar to finished surface	+ 1/4-inch
Lateral spacing of bars in plane of reinforcement in slabs and walls	± 1-inch
Height of bottom bars in slabs	+ 1/4-inch
Height of top bars in slabs	+ 1/4-inch

3.04 SHOP FABRICATION

- A. Reinforcing steel shall be fabricated to shapes and dimensions indicated on the Contract Drawings and in compliance with applicable provisions of ACI 315 and ACI 318.
- B. Bars shall be bent cold. Bars shall be prefabricated to detail and delivered to the site plainly tagged and ready to set.

3.05 FIELD FABRICATION

- A. Field fabrication of reinforcing steel will not be permitted without the approval of the GROUP'S REPRESENTATIVE.

3.06 PLACEMENT AND ANCHORAGE

- A. Space metal chairs, bolsters, spacers and hangers in accordance with ACI 315.
- B. Reinforcement, at the time concrete is placed, shall be free from rust scale or other coatings that will destroy or reduce bond. Bars with kinks or bends not shown on the plans shall not be used. A thin coating of firmly attached rust shall not be cause for rejection.
- C. Reinforcement shall be accurately placed in accordance with approved Shop Drawings and shall be adequately secured in position with not less than 16-gauge annealed wire or suitable clips at intersections. Reinforcement shall be held securely at the required distance from the forms. Nails shall not be driven into outside forms to support reinforcement.
- D. Install welded wire fabric reinforcement for concrete as required on the Contract Drawings. Lap all joints 6-inches and wire securely. Extend mesh to within 2-inches of sides and ends of slabs. Unless otherwise specified, place welded wire fabric between the upper third-point and the mid-point of the slab. Sheets that do not lay flat when in their intended position will be rejected. Tags designating the wire size and spacing shall be left on each sheet until ready for use. Tuck ends of welded mesh well down into edge of beams or walls. Do not leave unreinforced border strips. Welded wire fabric shall not contain loose rust.

3.07 CONCRETE COVER

- A. Metal reinforcement shall be protected by concrete cover in accordance with ACI 318.

3.08 SPLICING

- A. Splices shall be Class "B" splice minimum. The location and type of splices desired by the CONTRACTOR must be specifically requested and must meet the approval of the GROUP'S REPRESENTATIVE before they can be used.

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- B. Splices shall not be made at point of maximum stress and shall provide sufficient lap to transfer stress between bars by bond.
- C. Mechanical splices may be used instead of lap splices provided that their location and type meets with the approval of the GROUP'S REPRESENTATIVE and QAO.
- D. Stagger splice locations to prevent their alignment.

*****END OF SECTION*****

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall furnish and install cast-in-place concrete for the pumping well vaults, fence posts, and as shown and indicated on the Contract Drawings, as specified in this Section, as directed by the REMEDIAL DESIGNER, and as otherwise required to complete the Work.
- B. The CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations, and laws of local, municipal, state, or Federal authorities having jurisdiction. The CONTRACTOR shall provide a “Competent Person” to implement, supervise, and inspect all Work.

1.02 RELATED SECTIONS

- A. 01410 – Materials Testing Laboratory
- B. 03100 – Concrete Formwork
- C. 03200 – Concrete Reinforcement

1.03 REFERENCED PUBLICATIONS

The latest edition of the publications listed below form a part of these Specifications:

- A. American Concrete Institute (ACI) Publications
 - 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
 - 301 Specifications for Structural Concrete for Buildings
 - 302.1R Guide for Concrete Floor and Slab Construction
 - 304 Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
 - 305R Hot Weather Concreting
 - 306R Cold Weather Concreting
 - 318 Building Code Requirements for Reinforced Concrete
- B. U.S. Army Corps of Engineers (COE) Waterways Experiment Station Publications
 - CRD-C-572 Specifications for Polyvinyl Chloride Waterstops
 - CRD-C-621 Handbook for Concrete and Cement, Specifications for Non-shrink Grout, Volume II

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- C. American Association of State Highway and Transportation Officials (AASHTO) Publication
 - M 182 Burlap Cloth Made From Jute or Kenaf
- D. American Society for Testing and Materials (ASTM) Publications
 - C 31 Making and Curing Concrete Test Specimens in the Field
 - C 33 Concrete Aggregates
 - C 39 Compressive Strength of Cylindrical Concrete Specimens
 - C 42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
 - C 94 Ready-Mixed Concrete
 - C 143 Slump of Portland Cement Concrete
 - C 150 Portland Cement
 - C 171 Sheet Materials for Curing Concrete
 - C 172 Sampling Freshly Mixed Concrete
 - C 173 Air Content of Freshly Mixed Concrete by the Volumetric Method
 - C 231 Air Content of Freshly Mixed Concrete by the Pressure Method
 - C 260 Air-Entraining Admixtures for Concrete
 - C 309 Liquid Membrane-Forming Compounds for Curing Concrete
 - C 494 Chemical Admixtures for Concrete
 - C 595 Blended Hydraulic Cements
 - C 618 Fly Ash and Raw or Calcimined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
 - C 881 Epoxy-Resin-Base Bonding Systems for Concrete
 - D 1751 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

1.04 SUBMITTALS

- A. Submit concrete MANUFACTURER's mix design to the GROUP'S REPRESENTATIVE.
- B. Submit Shop Drawings showing the sequence for concrete placement and the location and details of joints, block-outs, openings, and other embedded items not shown on the Contract Drawings.
- C. Submit compression test results to the GROUP'S REPRESENTATIVE.
- D. Submit in accordance with Section 01300 of these Technical Specifications.

PART 2 – PRODUCTS

2.01 CEMENT

- A. Cement shall be standard Portland cement of American manufacture, conforming to ASTM C150, Type I. Only one brand of commercial Portland cement shall be used in the exposed concrete of the structure. Cement reclaimed by cleaning bags or from leaking containers shall not be used. Each bag shall weight approximately ninety-four (94) pounds and contain one (1) cubic foot of cement.

2.02 CONCRETE AGGREGATES

- A. Fine aggregates shall be sand having clean, hard, durable, uncoated grains and free from deleterious substances and shall conform to ASTM C33.
- B. Coarse aggregates shall be crushed stone having clean, hard, durable, uncoated particles conforming to ASTM C33. Aggregate for lightweight concrete shall conform to ASTM C330.

2.03 WATER

- A. Water used in mixing concrete shall from a potable water source and free from deleterious amounts of acids, alkalies or organic materials.

2.04 EXPANSION JOINT FILLER MATERIAL

- A. Expansion joint materials shall be asphalt-impregnated fiber strips, 1/2-inch thick, unless otherwise shown or noted in the Contract Documents, conforming to ASTM D1751.

2.05 WATERSTOPS:

- A. Where shown in the Contract Documents and/or otherwise required in expansion joints and construction joints, waterstops shall be polyvinyl chloride (PVC) and shall incorporate a galvanized steel wire along both edges which shall be used to secure the waterstop in position, by tying to reinforcement, during concrete placement. The waterstop shall be flat corrugated, 6-inches wide and 3/8-inch thick at its center. The waterstop shall extend the entire length of the joint; and, all splices shall be heat-welded and tested in accordance with the MANUFACTURER's instructions. Provide prefabricated tees, crosses, and other configurations as required for proper installation.

2.06 NON-SHRINK GROUT

- A. Non-shrink grout shall be a ready-to-use non-metallic aggregate product requiring only the addition of water at the jobsite, and shall conform to COE CRD-C-621.

2.07 VAPOR BARRIER

- A. Not Required

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2.08 ADMIXTURES

- A. Water reducing admixture shall conform to ASTM C494, Type A.
- B. Water reducing, retarding admixture shall conform to ASTM C494, Type D.
- C. Non-Corrosive, Non-Chloride Accelerator: The admixture shall conform to ASTM C494, Type C.
- D. Air entraining admixture shall conform to ASTM C260.
- E. High range water reducer (HRWR) shall conform to ASTM C494, Type F or G.
- F. Calcium Chloride: Calcium chloride or admixtures containing more than 0.1 percent chloride ions are not permitted.

2.09 CURING AND SEALING COMPOUNDS

- A. Curing compound shall be acrylic based, conforming to ASTM C309.
- B. Sealing-hardener compound shall conform to ASTM C309.

2.10 BONDING COMPOUNDS

- A. Bonding Compound shall conform to ASTM C881.

2.11 DRILLED ANCHORS

- A. Drilled anchors shall be Type 304 or Type 317 stainless steel and anchored to the concrete with and epoxy adhesive: Hilti HVA or HIT-C-100; Rawl Chem-Steed, Molly Parabond, or favorably reviewed equivalent.

PART 3 – EXECUTION

3.01 CONCRETE QUALITY

- A. All mix designs shall be proportioned in accordance with ACI 211.1. The proportioning shall be based on the requirements of a well-graded high-density plastic and workable mix within the slump range and strengths required. The following classes of concrete is required:
 - 1. Class A
 - a) Compressive strength at twenty-eight (28) days: 3000 psi (min.)
 - b) Slump shall be a maximum slump of three (3) inches.
 - c) Concrete shall have a maximum water-cement ratio of 0.50.
 - 2. Class AA
 - a) Compressive strength at twenty-eight (28) days: 3500 psi
 - b) Slump shall be a maximum slump of three (3) inches.
 - c) Concrete shall have a maximum water-cement ratio of 0.47.
 - 3. Class AAA
 - a) Compressive strength at twenty-eight (28) days: 4000 psi
 - b) Slump shall be a maximum slump of four (4) inches.
 - c) Concrete shall have a maximum water-cement ratio of 0.43.

- B. Slump: Testing frequency shall be as specified in Article 3.16A herein.
- C. Air Content: All concrete shall have an air content of five (5) to seven (7) percent. Testing frequency shall be as specified in Article 3.16A herein.
- D. Admixture Usage: All concrete shall contain a water reducing admixture or water reducing-retarding admixture, and an air entraining agent. All concrete placed at air temperatures below fifty (50) degrees Fahrenheit (F) shall contain the specified non-corrosive non-chloride accelerator. The use of admixtures allowed in this Specification is optional and subject to favorable review of the GROUP'S REPRESENTATIVE.

3.02 MIX DESIGNS

- A. The CONTRACTOR shall submit the concrete supplier's mix design and strength data for each class of concrete specified to document compliance with the specifications. The CONTRACTOR shall not use any concrete in this work without approval of the design mix by the GROUP'S REPRESENTATIVE.
- B. If the concrete production facility does not have a standard mix or test data meeting the requirements of this technical Specification, trial batches of the proposed mix shall be prepared by the production facility in accordance with ACI 211.1 and tested by an independent laboratory hired by the CONTRACTOR at no cost to the GROUP.
- C. For concrete placed by pumping, the mix design shall be adjusted, if required, to meet the recommendations of ACI 211.1.
- D. Compression test specimens made to verify the mixes shall be made in accordance with ASTM C192. Aggregates shall be tested in accordance with ASTM C33. All compression test specimens shall be tested in accordance with ASTM C39.
- E. Concrete materials, as specified under this Section, shall not be mixed by hand on-Site.

3.03 PLANT MIXING

- A. Proportioning Concrete
 - 1. Proportions shall be in compliance with approved design mix for each class of concrete.
 - 2. The mixing plant shall be fitted with adequate equipment and facilities for accurate measurement and control of the quantities of material and water used in the concrete.
 - 3. Concrete materials shall be measured by weight except for admixtures, which shall be measured by volume.

B. Batching

1. The CONTRACTOR shall provide all necessary equipment to accurately determine and control actual amount of materials entering into the concrete mix. Individual ingredients shall be weighted separately for each batch. Accumulative weighing will be allowed if equipment is in acceptable working order as determined by the testing laboratory and approved by the GROUP'S REPRESENTATIVE. Accuracy of all weighing devices shall be such that successive quantities can be measured to within one percent of the desired amount.
2. Completely discharge contents of the mixer before each new batch is loaded. Use of retempered concrete or wash water is not permitted.
3. Ready-mixed concrete shall be mixed and delivered in accordance with requirements of ASTM C94 and the following:
 - a. A separate water-metering device (not truck tank) shall be used for measuring water added to the original batch.
 - b. Use of wash water as a portion of the mixing water is not permitted. Wash water added to empty drums after discharging shall be removed before a new batch is received.
 - c. Centrally mixed concrete shall be mixed for the length of time specified herein, not "shrink-mixed".
 - d. Mixing drums shall be watertight.
 - e. Concrete shall be discharged within one hour from the time concrete was mixed, if centrally mixed, or from time the original water was added, if transit-mixed.
 - f. Furnish a delivery ticket with each load of concrete delivered under these Specifications to the QAO. Delivery ticket shall show clearly the class and strength of concrete, size of coarse aggregate, water per cubic yard, the slump ordered, quantities of all admixtures, and the date and time of departure from the batching plant.

3.04 CONVEYING EQUIPMENT

- A. If concrete is to be transported in carts or buggies, the carts or buggies shall be equipped with pneumatic tires.
- B. Equipment for chuting or other methods of conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at delivery without segregation of materials.

3.05 CONVEYING

- A. Concrete shall be conveyed from mixer to place of final deposit by methods that will prevent separation or loss of the material.
- B. Runway supports shall not bear upon reinforcing steel or fresh concrete.

- C. All conveying equipment shall be thoroughly cleaned before each run of concrete is begun.

3.06 DELIVERY AND PROTECTION OF MATERIALS

- A. Deliver ready-mixed concrete in compliance with requirements set forth in ASTM C94.

3.07 SEVERE-WEATHER PROVISIONS

A. Hot-Weather Concreting

1. Provide adequate methods of lowering temperature of concrete ingredients so that the temperature of concrete when placed does not exceed ninety (90) degrees F.
2. When the weather is such as to raise the as-placed concrete temperature consistently above ninety (90) degrees F, Pozzoloth retarder shall be used.
3. Subgrade and forms shall be wetted with water before placing of concrete. All excess water shall be removed before concrete is placed.
4. Curing shall start as soon as practicable to prevent evaporation of water. Flat work shall be protected from dry winds, direct sun and high temperatures.

B. Cold-Weather Concreting

1. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather. No frozen materials, or materials containing ice, shall be used.
2. All concrete materials and all reinforcement, forms, fillers and ground with which concrete is to come into contact shall be free from frost.
3. Whenever the temperature of the surrounding air is below forty (40) degrees F and falling, all concrete placed in the forms shall have a temperature of between seventy (70) and eighty (80) degrees F, and adequate means shall be provided for maintaining a temperature of not less than seventy (70) degrees F for three (3) days, or fifty (50) degrees F for five (5) days, or for as much more time as is necessary to insure proper curing of the concrete. If high early strength concrete is used, the requirement for maintenance of fifty (50) degrees F can be reduced to three (3) days.
4. Use only the specified non-chloride accelerator. Calcium chloride or admixtures containing more than 0.1 percent chloride ions are not permitted.
5. Housing, covering or other protection used in connection with curing shall remain in place and intact at least 24 hours after the artificial heat is discontinued.

3.08 CONSTRUCTION JOINTS

- A. Early in the construction program, the CONTRACTOR shall review with the QUALITY ASSURANCE OFFICER (QAO) any construction joints proposed for use, which are not indicated on the Contract Drawings. The CONTRACTOR shall not use any construction joints which are not approved by the GROUP'S REPRESENTATIVE. In all cases, construction joints shall occur at sections of minimum shear. Where construction joints are to be made, concrete surfaces shall be roughened (construction joints detailed with keyways in slabs and walls, are not required to be roughened) and thoroughly cleaned of foreign matter and laitance. In addition to the foregoing, joints shall be dampened with water and the specified bonding compound applied, or a slush coat of neat cement grout shall be applied.

3.09 INSPECTION OF WORK BEFORE PLACING

- A. The CONTRACTOR shall inspect the forms to receive concrete for any deficiencies which would prevent proper placing of concrete. Do not proceed with placing concrete until such deficiencies are corrected.
- B. The CONTRACTOR shall give the QAO at least forty-eight (48) hours notice before any concrete is to be cast. Concrete shall not be cast until the QAO has observed and given approval of the work to be cast including, but not limited to, the placement of all the reinforcing, accessories, forms and the surfaces to be cast against. Such observations are in the nature of assisting the CONTRACTOR to minimize errors and in no case will they serve to relieve the CONTRACTOR of the responsibility to provide the materials and workmanship required by the Contract Documents.
- C. The CONTRACTOR shall not place concrete on earth until the fill or excavation has been prepared as set forth under applicable Sections of the Specifications for that Work.
- D. The CONTRACTOR shall not place any item in the concrete that has not been authorized by the Contract Documents and/or the QAO. The CONTRACTOR shall insert all the items as required by the other trades and properly position and secure them in their intended location. Openings other than those, which are facilitated by sleeves, shall be properly formed and positioned as required by the other trades.
- E. Do not place concrete in forms until all foreign matter has been removed from forms and the reinforcing steel is in proper condition for placement of concrete.
- F. Remove hardened, or partially hardened, concrete on forms or reinforcement before placing concrete.

3.10 PLACING

- A. Deposit concrete as close as practicable in its final position to avoid segregation due to rehandling or flowing. Do not deposit concrete on work that has partially hardened or been contaminated by foreign material, and do not use retempered

concrete. In no case shall concrete be cast when the elapsed time after initial addition of water and cement to batch exceeds ninety (90) minutes, unless approved by the GROUP'S REPRESENTATIVE.

- B. Concrete shall be placed to avoid the displacement of reinforcing, and coating or spattering of the reinforcing steel. The placing of concrete within forms shall be regulated so that the pressure within the forms does not exceed design pressures. In placing concrete, each layer shall be placed following the preceding layer to prevent lines of separation or "cold joints". After the concrete reaches its initial set, jarring the formwork or placing strain or vibration on the ends of projecting reinforcing bars shall be carefully avoided.
- C. Concrete shall not be dropped more than four (4) feet. For greater distances of drop, concrete shall be handled with metal chutes or tremie pipes. Greater drops shall be permitted only if approved by the GROUP'S REPRESENTATIVE.
- D. Once concreting has started, it shall be carried on as a continuous operation until placing of concrete between construction joints is completed. The top surface shall be finished to the required alignment.
- E. Concrete shall be placed in layers not over 12-inches-deep and each layer shall be compacted with the aid of mechanical internal-vibrating equipment supplemented by hand spading. Vibrators shall in no case be used to transport concrete. Use of form vibrators will not be permitted. Internal vibrators shall maintain a speed of not less than five-thousand (5,000) impulses-per-minute when submerged in the concrete. At least one spare vibrator shall be maintained as a relief. Duration of vibrator use shall be limited to that necessary to produce satisfactory consolidation without causing objectionable segregation. Vibrator shall not be lowered into courses that have begun to set. Apply vibrator at uniformly spaced points not further apart than the visible effectiveness of the machine.
- F. Type and use of vibrators shall be in accordance with ACI 301.

3.11 PROTECTION

- A. Protect freshly placed concrete from damage or injury due to water, falling objects, persons or anything that may mar or injure finish surface on concrete. Only light use of the floor shall be permitted for the first seven (7) days after placing of concrete.

3.12 FINISHING

- A. Formed Surfaces: Formed surfaces shall be finished and/or patched after curing in accordance with Articles 3.15 and 3.14, respectively, of this Section.
- B. Interior Floor Slabs and Equipment Pads, if required: Interior floor slabs and equipment pads shall have a smooth-troweled finish in accordance with the following:
 - 1. Concrete shall be placed, consolidated, struck-off and leveled to the proper elevation. After the surface has stiffened sufficiently to permit the operation and the water sheen has disappeared, the surface shall be wood floated, by hand or power float, at least twice, to a uniform sandy

texture. Floors shall be leveled such that depressions between high spots do not exceed 1/4-inch under a 10-foot-long straightedge except where drains occur, in which case the floors shall be pitched to the drains as indicated on the Contract Drawings.

2. After the concrete has received a float finish, it shall be troweled at least twice to a smooth dense finish. The drying of the surface moisture before floating or troweling shall not be hastened by the dusting on of dry sand or cement. Both power and hand troweling shall be required. The first troweling shall be done by a power trowel and shall produce a smooth surface relatively free of defects. Additional troweling shall be done by hand after the surface has hardened sufficiently. The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The surface shall be thoroughly consolidated by the hand troweling operations. The finished surface shall be free of any trowel marks or other imperfections; shall be uniform in texture and appearance, and shall be in true plane within the tolerance specified. Any deviation from this condition, which remains after the troweling is completed, shall be corrected by grinding.

- C. Broom Finish: Broom finish shall be applied to all exterior sidewalks, walkways, working pads, platforms and all steps and landings both interior and exterior.

1. Concrete shall be placed, consolidated, struck-off and leveled to the proper elevation. After the surface has stiffened sufficiently to permit the operation and the water sheen has disappeared, the surface shall be wood floated, by hand or power float, at least twice, to a uniform sandy texture. Floors shall be leveled such that depressions between high spots do not exceed 1/4-inch under a 10-foot-long straightedge except where drains occur, in which case the floors shall be pitched to the drains as indicated on the Contract Drawings.
2. After the concrete has received a float finish, it shall be broomed with a flexible bristle broom or burlap belt drawn across the surface. Surface must be hardened sufficiently to retain the scoring or ridges. Scores or ridges shall be transverse to traffic or at right angles to the slope of the slab.

3.13 CURING

- A. All Slabs. After placement and finishing, concrete shall be maintained in a moist condition for at least seven successive days during which the temperature of the concrete is fifty (50) degrees Fahrenheit (F) or above. For temperatures of fifty (50) degrees F and below, curing period shall be fourteen (14) successive days.
1. Concrete shall be kept moist by any one, or combination, of the following methods:
 - a. Ponding or Immersion: Continually immerse the concrete in water throughout the curing period. Water shall not be more

than twenty (20) degrees F less than the temperature of the concrete.

- b. Fog Spraying or Sprinkling: Provide uniform and continuous application of water throughout the curing period.
- c. Pervious Sheeting: Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6-inches over adjacent sheeting. Sheeting shall be at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.
- d. Impervious Sheeting: Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12-inches minimum. Provide sheeting not less than 18-inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Inspect surface of concrete daily for wetness. The surface shall be kept continuously wet during the curing period.

B. All Other Concrete: After placement, concrete shall be maintained in a moist condition for the same periods as specified above.

- 1. Concrete in Formed Surfaces (Slabs, Beams, Columns and Building Walls, if applicable): Keep forms and exposed surfaces wet with water during the curing period. If forms are removed before the end of the curing period, apply a curing compound within one hour after form removal.

3.14 PATCHING

- A. Any concrete, which is not formed as required, or for any reason is out of alignment or level or shows a defective surface, or shows defects which reduce the structural adequacy of a member or members, as determined by the GROUP'S REPRESENTATIVE and/or QAO, shall be considered as not conforming with these Specifications and shall be removed from the Project by the CONTRACTOR at the CONTRACTOR's sole expense, unless the GROUP'S REPRESENTATIVE grants permission to patch the defective area. Permission to patch any such area shall not be considered a waiver of the QAO's right to require complete removal of the defective work if the patching does not, in the opinion of the QAO, satisfactorily restore the quality and appearance of the surface or the structural adequacy of the member or members.
- B. After removing the forms, all concrete surfaces shall be inspected and any joints, voids, stone pockets or defective areas permitted by the QAO to be patched and all tie holes, shall be patched. Defective areas shall be chipped away to a depth not less than one (1) inch with the edges perpendicular to the surface. Remove defective areas to sound concrete with clean, square cuts. Dampen concrete surfaces to be in contact with patching concrete and apply the specified bonding compound. Place patching concrete over the bonding compound as specified by

the MANUFACTURER. Place, compact and finish to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete. Surfaces prepared for patching shall be approved by the QAO prior to the application of the patching mix.

- C. Patching concrete mix (or mortar) shall be subject to the approval of the QAO. The patching concrete shall be compacted into place and screened off so as to leave the patch higher than the surrounding surface. It shall then be left undisturbed for a period of one to two hours to permit initial shrinkage before being finished. The patch shall be finished to match the adjoining surface. All patches shall be cured as specified for the original concrete.
- D. Tie holes left by withdrawal of rods or the holes left by removal of ends of wall ties shall be filled solid with mortar after first being wetted. For holes passing through the wall, a plunger-type grout gun shall be used to force the mortar through the wall starting at the back face. A piece of burlap or canvas shall be held over the hole on the outside and when the hole is filled, the excess mortar shall be struck off with the cloth flush with the surface. Holes not passing through the walls shall be filled using a small tool that will permit packing the hole solid with mortar. Any excess mortar at the surface of the wall shall be struck off flush with a cloth.

3.15 FINISHES ON FORMED SURFACES

Upon completion of patching, surfaces of concrete shall be finished as follows:

- A. Common finish shall be produced by filling all tie holes, honeycomb and depressions, and knocking off and evening up burrs and form marks.
- B. A rough finish shall be produced by filling all tie holes and honeycomb and in other respects leaving the surface as formed. All concrete surfaces which will be covered by earth or otherwise obstructed from view in the completed structure shall receive a rough finish.

3.16 TESTING LABORATORY

- A. The testing laboratory shall be paid by the CONTRACTOR. The laboratory shall have access to all places where concrete materials and concretes are manufactured, stored, proportioned, mixed, placed and tested. Duties shall include, but not necessarily be limited to, the following:
 - 1. Make, store, transport, cure and test compression specimens made during placing of concrete. Slump testing, air entrainment testing, and compression test specimens shall be tested in accordance with ASTM C39. Test reports shall show all pertinent data, such as class of concrete, exact location of pour, air temperature, date of pour, time of pour, truck number for ready-mixed concrete, date on which specimen was broken, age of specimen, compressive strength of specimen, slump test results, and air content of pour from which the specimen was made. One copy each of all tests shall be sent to the CONTRACTOR and copies of each to the QAO and GROUP'S REPRESENTATIVE.

2. Collect four standard test cylinders from each ten (10) cubic-yards of concrete delivered to the job Site, or once per truck, whichever is less. Two (2) of these cylinders shall be designated for the 28-day test and shall comprise a test under the definition of these Specifications. One cylinder will be broken at seven days and will be used as an aid in determining the early strength of the concrete and the 28-day strength, and one cylinder retained in reserve for later testing if required.
 3. Perform slump and air entrainment testing once per every ten (10) cubic yards of concrete delivered to the job Site, or once per truck, whichever is less.
 4. Periodically inspect the batching plant and file a report with the QAO stating whether the MANUFACTURER's equipment and methods meet the requirements of these Specifications.
- A. Temperature and Placing Record: Temperature record shall be made each day during the concreting operations. Records shall also include location, quantity and starting and finishing time of placement for all concrete work. Copy distribution shall be as specified above for test reports.

3.17 EVALUATION OF COMPRESSION TESTS

- A. Evaluation of compression test results shall be as follows:
1. For each class of concrete, compressive-strength tests for laboratory-cured cylinders shall be considered satisfactory if the averages of the results of all sets of three consecutive compressive-strength tests equal or exceed the 28-day design compressive-strength specified; and, no individual cylinder strength test falls below the required compressive strength by more than five-hundred (500) psi. Strength tests of specimens cured under field conditions may be required by the QAO to check the adequacy of curing and protecting of the concrete placed. Specimens shall be molded by the field quality-control laboratory at the same time and from the same batch as the laboratory-cured specimens.
- B. Faulty Concrete: Failure to meet any of the specified conditions constitutes faulty concrete. Unless otherwise directed by the QAO, faulty concrete shall be removed and replaced with concrete as specified, at no expense to the GROUP.
- C. Additional Testing: If permitted by the QAO, additional testing shall be subject to the approval of GROUP'S REPRESENTATIVE at no expense to the GROUP. Load testing, if permitted by the QAO, shall be conducted in accordance with the loading criteria as required by the design of the structure, as determined by the GROUP.
- D. Neither the results of laboratory verification tests nor any provision in the Contract Documents shall relieve the CONTRACTOR of the obligation to furnish concrete of the class and strength specified.

*****END OF SECTION*****

SECTION 03400

PRE-CAST CONCRETE

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The CONTRACTOR shall provide pre-cast concrete structures for the pumping well vaults, and as shown and indicated on the Contract Drawings, as specified in this Section, as directed by the REMEDIAL DESIGNER, and as otherwise required to complete the Work.
- B. The CONTRACTOR shall comply with applicable codes, ordinances, rules, regulations, and laws of local, municipal, state, or Federal authorities having jurisdiction. The CONTRACTOR shall provide a “Competent Person” to implement, supervise, and inspect all Work.

1.02 RELATED SECTIONS

- A. 01410 – Materials Testing Laboratory
- B. 03100 – Concrete Formwork
- C. 03200 – Concrete Reinforcement
- D. 02220 – Excavation
- E. 02223 – Backfill and Fill

1.03 REFERENCES

- A. ASTM A615 – Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
- B. ASTM C150 – Portland Cement.
- C. PCI MNL-116 – Manual for Quality Control for Plants and Production of Pre-Cast and Prestressed Concrete Products.
- D. PCI MNL-120 – Design Handbook – Pre-Cast and Prestressed Concrete.
- E. PCI MNL-123 – Manual on Design of Connections for Pre-Cast Prestressed Concrete.
- F. ACI 304 – Guide for Measuring, Mixing, Transporting and Placing Concrete
- G. ACI 318 – Building Code Requirements for Reinforced Concrete
- H. ASTM C478 – Specification for Pre-Cast Reinforced Concrete Manholes Sections
- I. ASTM C825 – Standard Specification for Pre-Cast Concrete Barriers

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- J. ASTM C857 – Standard Practice for Minimum Structural Design Loading for Underground Pre-Cast Concrete Utility Structures
- K. ASTM C858 – Standard Specification for Underground Pre-Cast Concrete Utility Structures”
- L. ASTM C890 – Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Pre-Cast Concrete Water and Wastewater Structures
- M. ASTM C913 – Standard Specification for Pre-Cast Concrete Water and Wastewater Structures
- N. ASTM C923 – Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
- O. ASTM C936 – Standard Specification for Solid Concrete Interlocking Paving Units
- P. ASTM C990 – Standard Specification for Joints for Concrete Pipe, Manholes and Pre-Cast Box Sections Using Preformed Flexible Joint Sealants
- Q. ASTM 1433 – Standard Specification for Pre-Cast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
- R. ASTM C1478 – Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes and Laterals
- S. AWS D1.1 – Structural Welding Code - Structural Steel
- T. AWS D1.4 – Structural Welding Code - Reinforcing Steel
- U. CRSI Manual of Standard Practice

1.04 SUBMITTALS

The CONTRACTOR shall provide the following:

- A. Submit in accordance with Section 01300 of these Technical Specifications.
- B. Submit shop drawings, field sketches, and Manufacturer’s technical data to the REMEDIAL DESIGNER for review and approval prior to purchase and installation of the pre-cast concrete vault and accessories.
- C. Indicate material specifications, dimensions, capacity, size, and location of openings, reinforcing details, and accessory locations on any shop drawings or field sketches submitted.
- D. Submit Manufacturer’s installation instructions for review by the REMEDIAL DESIGNER.

1.05 QUALITY ASSURANCE

- A. The CONTRACTOR shall perform work in accordance with the requirements of PCI MNL-116, PCI MNL-123, PCI MNL-120.
- B. Pre-cast concrete producer shall demonstrate adherence to the standards set forth in the National Pre-Cast Concrete Association Quality Control Manual. Pre-cast concrete producer shall meet requirements written in Subparagraphs 1 or 2.

1. NPCA Certification – The pre-cast concrete producer shall be certified by the National Pre-Cast Concrete Association's Plant Certification Program prior to and during production of the products for this project.

2. Qualifications, Testing and Inspection

- a. The pre-cast concrete producer shall have been in the business of producing Pre-Cast concrete products similar to those specified for a minimum of five (5) years. The pre-cast concrete producer shall maintain a permanent quality control department or retain an independent testing agency on a continuing basis. The agency shall issue a report, certified by a licensed engineer, detailing the ability of the pre-cast concrete producer to produce quality products consistent with industry standards.
- b. The pre-cast concrete producer shall show that the following tests are performed in accordance with the ASTM standards indicated. Tests shall be performed for each one-hundred-fifty (150) cubic-yards of concrete placed, but not less frequently than once (1) per week.
 - 1. Slump: C143
 - 2. Compressive Strength: C31, C192, C39
 - 3. Air Content (when air-entrained concrete is being used): C231 or C173
 - 4. Unit Weight: C138
- c. The pre-cast concrete producer shall provide documentation demonstrating compliance with this subparagraph.
- d. The GROUP may place an inspector in the plant when the products covered by this specification are being manufactured.

1.06 QUALIFICATIONS

- A. The Fabricator shall be a company specializing in manufacturing the work of this section with minimum five (5) years experience.

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1.07 DELIVERY, STORAGE, AND HANDLING

The CONTRACTOR shall:

- A. Deliver, store, protect, and handle products to site as instructed by the GROUP'S REPRESENTATIVE.
- B. Handle precasts structure in position consistent with its shape and design. Lift and support only from support points.
- C. Provide lifting or handling devices capable of supporting structure in positions anticipated during manufacture, storage, transportation, and erection.
- D. Protect structure to prevent staining, chipping, or spalling of concrete.

PART 2 – PRODUCTS

2.01 PRE-CAST CONCRETE PUMPING WELL VAULTS

The CONTRACTOR shall supply and install pre-cast concrete vaults conforming to the following:

- A. Pre-cast concrete shall be air-entrained, minimum 4,000 psi compressive strength at 28 days.
- B. The vaults shall be as specified in the Construction Drawings.
- C. The steps in the vault shall be built into the walls of pre-cast section to set in straight alignment so as to form a continuous ladder with maximum 8-inch-spacing rungs. Steps shall be 12-inch-wide, aluminum drop type steps, shall project six (6) inches from the manhole wall and shall extend into the vault wall.
- E. Grout to be used shall be premixed non-shrink compound with non-metallic aggregate, cement, water reducing and plasticizing agents capable of developing minimum yield strengths of 4,000 psi at twenty-eight (28) days.

2.02 FABRICATION

The Manufacturer shall:

- A. Provide fabrication procedures conforming to PCI MNL-116.
- B. Maintain plant records and quality control program during production of pre-cast structure. Make records available upon request.
- C. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are embedded and located as indicated on shop drawings.

2.03 SUMP COVERS

The CONTRACTOR shall provide covers meeting the following requirements:

- A. The vaults shall be fitted with three (3) foot by three (3) foot square aluminum vault doors (Type J-4AL), as manufacturer by The Bilco Company, or approved equal, of New Haven, Connecticut. Cover(s) shall be (aluminum) 1/4" diamond pattern plate reinforced on the underside to withstand a live load of three -hundred (300) pounds-per-square foot with maximum deflection of 1/150th of the span. Frame shall be 1/4" (6.3 mm) extruded aluminum with strap anchors bolted to the exterior.
- B. A stainless steel snap lock with fixed turn handle shall be mounted on the underside of the cover. A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the cover. Cover(s) shall have a lift handle that is designed to flush with the walking surface when not in use. Hardware shall be zinc plated and chromate sealed. All fasteners shall be Type 316 stainless steel.

2.04 FINISHES

- A. Formed non-architectural surfaces: Surfaces cast against approved forms using industry practice in cleaning forms, designing concrete mixes, placing and curing concrete. Normal color variations, form joint marks, small surface holes caused by air bubbles, and minor chips and spalls will be tolerated but no major imperfections, honeycombs or other defects will be permitted.
- B. Unformed surfaces: Surfaces finished with a vibrating screed, or by hand with a float. Normal color variations, minor indentations, minor chips and spalls will be tolerated but no major imperfections, honeycombs, or other defects shall be permitted.
- C. Special finishes:
 - 1. Troweled, broom or other finishes shall be according to the requirements of project documents and performed per industry standards or supplier specifications.
 - 2. Pre-Cast concrete producers shall submit finishes for approval when required by the project documents. The sample finishes shall be approved prior to the start of production.
- D. Patching and Repairs
 - 1. No repair is required to formed surfaces that are relatively free of air voids and honeycombed areas, unless the surfaces are required by the design to be finished.

2. Repairing Minor Defects - Defects that will not impair the functional use or expected life of a manufactured Pre-Cast concrete product may be repaired by any method that does not impair the product.
3. Repairing Honeycombed Areas - When honeycombed areas are to be repaired, all loose material shall be removed and the areas cut back into essentially horizontal or vertical planes to a depth at which coarse aggregate particles break under chipping rather than being dislodged. Proprietary repair materials shall be used in accordance with the manufacturer's instructions. If a proprietary repair material is not used, the area shall be saturated with water and, immediately prior to repair, the area should be damp, but free of excess water. A cement-sand grout or an approved bonding agent shall be applied to the chipped surfaces, followed immediately by consolidating an appropriate repair material into the cavity.
4. Repairing Major Defects - Defects in pre-cast concrete products which impair the functional use or the expected life of products shall be evaluated by qualified personnel to determine if repairs are feasible and, if so, to establish the repair procedure.

2.05 MATERIALS

- A. Concrete - Concrete shall be a uniform mix of quality materials listed in Article 2.4. Mix proportions shall be determined by following the standards in ACI 318 Chapter 5. Recommendations for selecting proportions for concrete are given in detail in Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete (ACI 211.1). Recommendations for lightweight concrete are given in Standard Practice for Selecting Proportions for Structural Lightweight Concrete (ACI 211.2).

1. Water-Cement Ratio

Concrete that will be exposed to freezing and thawing shall contain entrained air and shall have water-cement ratios of 0.45 or less. Concrete which will not be exposed to freezing, but which is required to be watertight, shall have a water-cement ratio of 0.48 or less if the concrete is exposed to fresh water, or 0.45 or less if exposed to brackish water or sea water. For corrosion protection, reinforced concrete exposed to deicer salts, brackish water or seawater shall have a water-cement ratio of 0.40 or less.

2. Entrained Air Content

The entrained air content of concrete that will be exposed to freezing conditions shall be within the limits given in Table 1.

Table 1
Total Entrained Air Content for Frost-Resistant Concrete

Nominal Maximum Aggregate Size (In.)	Entrained Air Content (%)	
	Severe Exposure	Moderate Exposure
3/8	6.0 to 9.0	4.5 to 7.5
1/2	5.5 to 8.5	4.0 to 7.0
3/4	4.5 to 7.5	3.5 to 6.5
1	4.5 to 7.5	3.0 to 6.0
1-1/2	4.5 to 7.0	3.0 to 6.0

*For specified compressive strengths greater than 5,000 psi, air content may be reduced 1%.

3. Compressive Strength

All concrete shall develop a minimum compressive strength of 4,000 psi in twenty-eight (28) days, unless other strengths are designated on the drawings.

- B. Portland Cement: ASTM C150, Type I, II, III or V.
- C. Aggregates: ASTM C33 or C330.
- D. Water: Potable or free of deleterious substances in amounts harmful to concrete or embedded metals.
- E. Admixtures:
 - 1. Air-entraining: ASTM C260
 - 2. Water reducing, retarding, accelerating, high range water reducing: ASTM C494
 - 3. Pozzolans, fly ash and other mineral admixtures: ASTM C618
 - 4. Ground granulated blast furnace slag: ASTM C989
 - 5. Pigments: Non-fading and lime-resistant

2.05 REINFORCEMENT AND CONNECTION MATERIALS

- A. Provide all reinforcement, accessory and connection materials required. Concrete reinforcement shall be steel bars or welded wire fabric, or a combination thereof.
- B. Reinforcing Bars:
 - 1. Deformed Billet-steel: ASTM A615
 - 2. Deformed Rail-steel: ASTM A616
 - 3. Deformed Axle-steel: ASTM A617
 - 4. Deformed Low-alloy steel: ASTM A706

C. Reinforcing Wire:

1. Plain Wire: ASTM A82
2. Deformed Wire: ASTM A496

D. Welded Wire Fabric:

1. Plain Wire: ASTM A185
2. Deformed Wire: ASTM A497

E. Epoxy Coated Reinforcement:

1. Reinforcing Bars: ASTM A775
2. Wires and Fabric: ASTM A884

F. Galvanized Reinforcement:

1. Reinforcing Bars: ASTM A767

G. Inserts and Embedded Metal - All items embedded in concrete shall be of the type required for the intended task, and meet the following standards:

1. Structural steel plates, angles, etc: ASTM A36
2. Proprietary items: In accordance with manufacturers published literature
3. Welded studs: AWS D1.1
4. Finishes (as required):
 - a. Shop primer: Manufacturers' standards
 - b. Hot-dipped galvanized: ASTM A152
 - c. Zinc-rich coating: MIL-P-2135 self-curing, one component, sacrificial
 - d. Cadmium coating: Manufacturers' recommendations

H. Joint Sealant and Joint Gaskets:

1. Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets: ASTM C443.
2. External Sealing Bands for Noncircular Sewer, Storm Drain, and Culvert Pipe: ASTM C877.
3. Joints for Concrete Pipe, Manholes, and Manufactured Box Sections Using Preformed Flexible Joint Sealants: ASTM C990
4. Specification for Elastomeric Joint Sealants: ASTM C920

I. Pipe Entry Connectors:

Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals: ASTM C923.

J. Grout:

1. Cement grout: Portland cement with enough water for the required strength and sand for proper consistency; may contain mineral or chemical admixtures, if approved by the REMEDIAL DESIGNER.
2. Non-shrink grout: Premixed, packaged expansive and non-expansive shrink-resistant grout.

2.06 FABRICATION

- A. Forms for manufacturing pre-cast concrete products shall be of the type and design consistent with industry standards. They should be capable of consistently providing uniform products and dimensions. Forms shall be constructed so that the forces and vibrations to which the forms will be subjected can cause no product damage.

1. Forms shall be cleaned of concrete build-up after each use.
2. Form release agents shall not be allowed to build up on the form casting surfaces.

B. Reinforcement

Cages of reinforcement shall be fabricated either by tying the bars, wires or welded wire fabric into rigid assemblies or by welding where permissible in accordance with AWS D1.4. Reinforcing shall be positioned as specified by the design and so that the concrete cover conforms to requirements. The tolerance on concrete cover shall be one-third of that specified but not more than ½-inch. Concrete cover shall not be less than ½-inch. Positive means shall be taken to assure that the reinforcement does not move significantly during the casting operations.

C. Embedded Items

Embedded items shall be positioned at locations specified in the design documents. Inserts, plates, weldments, lifting devices and other items to be imbedded in Pre-Cast concrete products shall be held rigidly in place so that they do not move significantly during casting operations.

D. Placing Concrete

1. Concrete shall be deposited into forms as near to its final location as practical. The free fall of the concrete shall be kept to a minimum. Concrete shall be consolidated in such a manner that segregation of the concrete is minimized and honeycombed areas are kept to a minimum. Vibrators used to consolidate concrete shall have frequencies and amplitudes sufficient to produce well consolidated concrete.

2. Cold Weather Requirements - Recommendations for cold weather concreting are given in detail in Cold Weather Concreting reported by ACI Committee 306.
 - a. Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near-freezing weather.
 - b. All concrete materials and all reinforcement, forms, fillers, and ground with which concrete is to come in contact shall be free from frost.
 - c. Frozen materials or materials containing ice shall not be used.
 - d. In cold weather the temperature of concrete at the time of placing shall not be below forty-five (45) degrees Fahrenheit (F). Concrete that freezes before its compressive strength reaches five-hundred (500) psi shall be discarded.
3. Hot Weather Requirements - Recommendations for hot weather concreting are given in detail in Hot Weather Concreting reported by ACI Committee 305.

During hot weather, proper attention shall be given to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation that could impair required strength or serviceability of the member or structure. The temperature of concrete at the time of placing shall not exceed ninety (90) degrees F.

E. Curing

1. Curing by Moisture Retention - Moisture shall be prevented from evaporating from exposed surfaces until adequate strength for stripping (Article 2.6, paragraph F) is reached by one of the following methods:
 - a. Cover with polyethylene sheets having a minimum thickness of 6-mils.
 - b. Cover with burlap or other absorptive material and keep continually moist.
 - c. Use of a membrane-curing compound applied at a rate not to exceed two-hundred (200) square-feet-per-gallon, or per manufacturers' recommendations.
2. Surfaces that will be exposed to weather during service shall be cured as above a minimum of three (3) days. Forms shall be considered effective in preventing evaporation from the contact surfaces. If air temperature is below fifty (50) degrees F the curing period shall be extended.
3. Curing with Heat and Moisture

Concrete shall not be subjected to steam or hot air until after the concrete has attained its initial set. Steam, if used, shall be applied within a suitable

enclosure, which permits free circulation of the steam. If hot air is used for curing, precautions shall be taken to prevent moisture loss from the concrete. The temperature of the concrete shall not be permitted to exceed one-hundred-sixty (160) degrees F. These requirements do not apply to products cured with steam under pressure in an autoclave.

F. Stripping Products from Forms

Products shall not be removed from the forms until the concrete reaches the compressive strength for stripping required by the design. If no such requirement exists, products may be removed from the forms after the final set of concrete provided that stripping damage is minimal.

G. Shipping Products

Products shall not be shipped until they are at least five (5) days old, unless it can be shown that the concrete strength has reached at least seventy-five (75) percent of the specified twenty-eight (28) day strength, or that damage will not be caused which will impair the performance of the product.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. The CONTRACTOR shall verify that Site conditions are ready to receive work and field measurements are as shown on shop drawings and construction drawings.

3.02 INSTALLATION

The CONTRACTOR shall provide the following:

- A. The excavation for vaults shall be free of debris, standing water, snow and ice and any obstructions. A minimum clearance of 12 inches shall be provided around the perimeter of the vault.
- B. All pre-cast structures shall be set on a foundation of at least twelve (12) inches of coarse aggregate, AASHTO 57 Stone, compacted using mechanical tampers to ninety (90) percent modified proctor as shown on Construction Drawings.
- C. Install and seal pre-cast sections in accordance with the Manufacturer's instructions.
- D. Waterproof exterior and interior surfaces of all pre-cast sections prior to installation.
- E. Install the piping as shown on the Construction Drawings. After the pipe has been installed, the openings shall be grouted with non-shrink grout.

- F. Waterproof exterior and interior joints, and patch at the pipe penetration points after the grouting or patching concrete has fully cured.
- G. Backfill around pre-cast concrete structures shall consist of appropriate material as specified in Section 02223 of these Technical Specification. No voids shall remain in between walls and native soil excavation. Each layer of backfill shall not exceed six (6) inches in compacted thickness.
- H. All excavated materials shall be disposed of as specified in Sections 02220 and 02221 of these Technical Specifications.
- I. Maintain elevations and grades as shown on the Construction Drawings and as approved by the GROUP'S REPRESENTATIVE in the field.

*****END OF SECTION*****

SECTION 08110

STEEL DOORS AND FRAMES

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The work covered by this Section consists of providing all labor, equipment and material required to furnish and install all steel doors, frames and related work as described herein and/or shown on the Contract Drawings.

1.02 RELATED SECTIONS

- A. Section 08710 – Finish Hardware
- B. Section 08735 – Weather-Stripping and Thresholds
- C. Section 13120 – Pre-Engineered Metal Buildings

1.03 SUBMITTALS

- A. CONTRACTOR shall submit complete shop drawings and engineering data in connection to all steel door and frame materials.
- B. Shop drawings shall indicate elevations of each door type, details of each frame type, location in the building for each item, conditions and special details of construction, methods of assembling sections, locations and installation requirements for hardware, size, shape and thickness of materials, joints and connections and finishing system.
- C. Submit in accordance with Section 01300 of these Technical Specifications.

1.04 TRANSPORTATION AND HANDLING

- A. For welded type frames, provide temporary steel spreaders fastened across bottom of frames where construction will permit concealment; leave spreaders in place after installation, otherwise remove spreaders after frames are set and anchored. In place of spreaders, frames may be strapped or in packages. Before shipping, label each frame and door with metal or plastic tags to show their location, size, door swing and other pertinent information.

1.05 STORAGE AND PROTECTION

- A. Protect doors and frames from damage during transportation and at the job site. Store doors and frames at the site, under cover, on wood blocking or on suitable floors. After installation, protect doors and frame from damage during subsequent

construction activity. Damaged work will be rejected and shall be replaced with new work.

1.06 QUALITY ASSURANCE

- A. The manufacturer shall provide written certification to the OWNER's REPRESENTATIVE that all products furnished comply with all applicable requirements of these Specifications.

PART 2 – PRODUCTS

2.01 MATERIALS AND CONSTRUCTION

- A. All hollow steel doors and frames shall be the product of a member of the Steel Door Institute and National Association American Metal Manufacturer (NAAMM). Doors and frames shall conform to the requirements of Steel Door Institute SDI-100 and SDI-112 for Type III extra heavy-duty doors.
- B. Metal Frames
 - 1. Location and Type: All metal frames for doors shall be formed of steel to sizes and shapes indicated. Frames shall be combination type with integral trim and fabricated with full welded unit and shall be the double rabbet design.
 - 2. Type and Gauges of Metal: Metal for frames shall be cold-rolled, steel sheets with clean, smooth surfaces complying with ASTM A366. Except where other gauges are indicated or specified, frames shall be fabricated from steel, not lighter than sixteen (16) gauge. Provide concealed metal reinforcement for hardware as required. The gauges of metal for reinforcement shall be in accordance with the Manufacturer's recommendations for the type of hardware, and the thickness and width of doors to be hung in the frame, provided that the gauges used are not lighter than seven (7) gauge for hinges, twelve (12) gauge for closers and fourteen (14) gauge for lock strikes and rod strikes. Exterior frames shall be galvanized steel.
 - 3. Workmanship and Design: The finished work shall be strong and rigid, neat in appearance and free from defects. Fabricate molded members straight and true with corner joints well formed, in true alignment and fastenings concealed where practicable. At exterior frames provide a caulking groove 1/4-inch wide by 5/8-inch deep, with a closed back to receive the caulking compound. Frames shall be manufactured and machined to within $\pm 1/32$ inch of required dimensions.

4. Forming Corner Joints: Joints for welded frames shall be mitered, mechanically interlocked, and arc-welded for full width of frame and trim. All contact edges shall be closed tight and all welds on exposed surfaces dressed smooth and flush.
5. All frames shall be of the rigid welded type.
6. Provisions for Hardware: Frames shall be prepared at the factory for the installation of hardware in accordance with the requirements of Section 08710 of these Technical Specifications. Welding of hinges to frames shall not be permitted. Frames shall be mortised, reinforced, drilled and tapped to templates to receive all mortised hardware. Frames to receive surface applied hardware shall be provided with reinforcing plates only. Provide cover boxes in back of all hardware cutouts. Doorframes shall be punched to receive rubber or vinyl door silencers. Provide three (3) silencers on lock sides of single doors. Furnish the required number and type of silencers with the frames. Lock strikes shall be set out and adjusted to provide clearance for silencers. All hardware preparation and reinforcement shall be in accordance with Steel Door Institute SDI 107.
7. Wall Anchors: Provide metal anchors of shapes and sizes required for the adjoining type of wall construction. Fabricate jamb anchors of steel, not lighter than the gauge used for frame. Then locate anchors on jambs near the top and bottom of each frame and at intermediate points not over 24-inches apart.
8. Floor Anchors: Provide floor clips of not less than sixteen (16) gauge steel and fasten to bottom of each jamb member for anchoring frame to floor construction. Clips shall be adjustable and drilled for 3/8-inch diameter anchor bolts. Anchors shall be galvanized.
9. Extension Clips: Where floor fill occurs, the bottom of frames shall terminate at the indicated finished floor levels and be supported by an adjustable extension clip angle resting on and anchored to the structural slab.
10. Frame Prime Coat: All surfaces of all frames that will be concealed after the installation shall receive a field application of an approved coat of asphaltic bituminous primer paint.
11. Frames shall be prime-painted at the factory in accordance with 3.02 of this Section.

C. Flush Hollow Metal Doors

1. General Requirements: Doors indicated on Drawings as flush hollow metal shall comply with the type, or types, or construction as specified. Doors shall be furnished as a package unit complete with frames as specified herein before and prepared to receive the hardware in accordance with the requirements of Section 08710 of these Specifications.
2. Construction: Hollow metal doors shall be of the flush, seamless, extra heavy-duty type for high use, industrial applications. Doors shall be constructed using sixteen (16) gauge sheet steel face panels either welded to a reinforced steel core or chemically bonded to a composite core. Core shall be constructed of rigid urethane foam, rigid polystyrene foam, phenolic resin impregnated hexagonal honeycomb, or a metal grid fabricated from sixteen (16) gauge steel channels. Doors constructed using metal spacers or a metal grid shall be filled with glass fiber insulation. Top and bottom edges of door shall be formed with continuous, minimum sixteen (16) gauge steel channels. Top and bottom edges shall be finished flush and sealed against water penetration. Hinge edge shall be reinforced with a continuous, minimum fourteen (14) gauge steel channel built up to additional thickness at hinges. Lock edge shall be reinforced with a continuous fourteen (14) gauge steel channel or bar. Internal reinforcement for lock and exit hardware shall be box type, minimum sixteen (16) gauge, with reinforcing plates on both sides of door. Internal reinforcement for closers and overhead holders shall be twelve (12) gauge, located on both sides of door. Edge seams formed by face sheets at hinge and lock stiles shall be continuously arc-welded top to bottom and ground smooth.
3. Type and Gauges of Metal: Metal for doors shall be cold-rolled sheets with clean smooth surfaces. The gauges of metal shall be as herein specified. Metal shall be phosphate treated prior to painting. Exterior doors shall be galvanized prior to painting.
4. Workmanship: The finished work shall be rigid, neat in appearance and free from defects. Form molded members shall be straight and true, with joints coped or mitered, well formed and in true alignment. All welded joints on exposed surfaces shall be dressed smooth so they are invisible after finishing.
5. Door Sizes and Clearances: Doors shall be of type and design indicated with dimensions of 3'-0" wide by 7'-0" high by 1-3/4-inch thick. The clearances for doors shall be 1/8-inch maximum at jambs and heads, 1/8-inch maximum at meeting stiles of pairs of doors, 3/4-inch maximum at sills without thresholds and 1/4-inch maximum between threshold and door.

6. Stile Edges: The lock edges of stiles shall be rounded for double-acting doors and beveled 1/8-inch in two (2) inches for other hollow metal doors. Double beveled and straight edge doors are acceptable, providing they will swing free under all operating conditions.
7. Weather-stripping: Weather-stripping shall be furnished in accordance with the requirements of Section 08735 of these Specifications.
8. Provisions for Hardware: Mortise, reinforce, drill and tap doors at factory to receive all hardware in accordance with the requirements of Section 08710 of these Specifications. Doors shall be field drilled and tapped for surface hardware. Provide metal reinforcing plates for locks and all mortised hardware as required. The gauges of metal for reinforcing plates shall comply with the Manufacturer's recommendations for the type of hardware used and the size required by commercial standard. All hardware preparation and reinforcement shall be in accordance with Steel Door Institute SDI 107.
9. Location of Hardware: The location of hardware in connection with hinged and other swing type hollow metal doors and frames shall be in accordance with the Manufacturer's current printed specifications.
10. Thermal Rated Doors: All exterior flush metal doors shall have an apparent U factor not to exceed 0.10 btu/square foot/hour/°F. Sponge neoprene seals and automatic door bottoms shall comply with the requirements of Section 08735 as applicable.

D. Stick Assemblies

1. Stick assemblies shall be fabricated from sixteen (16) gauge, cold rolled steel, accurately cut and welded together at the factory into a rigid frame. Frame assembly shall be phosphatized and finished as specified herein for metal frames.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Installation of Metal Frames: Set frames in position, plumb, align and brace securely until permanent anchors are set. Anchor bottom of frames to floors with expansion bolts, or with power fasteners. Build wall anchors into walls, or secure to adjoining construction as indicated or specified. All methods shall be in conformance with the Manufacturer's recommendations and Steel Door Institute

SDI 105. Metal frames shall be field painted after installation to match door panels.

- B. Installation of Metal Doors: Hang doors after frames are securely in place in conformity with the Manufacturer's recommendations. Make necessary adjustments after door is installed so that it operates with maximum ease and efficiency. The Manufacturer shall provide one pint of each finish color to the field for touch-up of all nicks, mars and other imperfections.

3.02 SURFACE PREPARATION AND SHOP PAINTING

- A. Primed Finish: Apply a primer finish to all ferrous metal surfaces furnished under this Section. Clean and phosphatize metal surfaces to assure maximum paint adherence, follow with a dip or spray coat of rust-inhibitive primer on all exposed surfaces. Primer shall be oven-baked for maximum hardness and durability. Primer shall be capable of passing a two-hundred (200) hour salt spray test in accordance with ASTM B 117.

3.03 ADJUSTMENT AND CLEANING

- A. Prime Coat Touch-Up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.
- B. Final Adjustments: Check and readjust operating finish hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

****END OF SECTION****

SECTION 08331

OVERHEAD COILING DOORS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The work covered by this Section consists of providing all labor, equipment and materials required to furnish, install and place into satisfactory operation, rolling service doors, including operators, guides, brackets and accessories, as specified herein and/or shown on the Contract Drawings.

1.02 RELATED SECTIONS

- A. Section 09900 – Painting
- B. Section 13120 – Pre-Engineered Metal Buildings

1.03 DESIGN REQUIREMENTS

- A. Coiling doors shall be designed for a wind load of not less than twenty-five (25) pounds per square foot (psf) (combined internal and external pressures) and shall conform to the applicable standards of the American Rolling Door Institute. Size of doors shall be as specified on the Contract Drawings.
- B. Coiling doors shall be designed for a frequency of operation of not less than ten (10) times a day.
- C. Operator shall be designed so that a pull of not more than thirty-five (35) pounds is required to raise door.

1.04 SUBMITTALS

- A. Complete shop drawings and engineering data shall be submitted to the OWNER's REPRESENTATIVE for all specified overhead coiling doors.
- B. Complete copies of the manufacturer's operation and maintenance data on the overhead coiling doors shall be submitted to the OWNER's REPRESENTATIVE.
- C. Submit in accordance with Section 01300 of these Technical Specifications.

1.05 STORAGE AND PROTECTION

- A. The doors shall be stored and protected from damage due to handling and weather and in accordance with manufacturer's recommendations. After installation,

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protect overhead coiling doors from damage during subsequent construction activity. Damaged work will be rejected and shall be replaced with new work.

1.06 QUALITY ASSURANCE

- A. The manufacturer shall provide written certification to the OWNER's REPRESENTATIVE that all products furnished comply with all applicable requirements of these Technical Specifications.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Coiling doors shall be equal to those manufactured by the Overhead Door Corporation.

2.02 MATERIALS AND CONSTRUCTION

A. Curtain and Guides

1. The curtain shall be constructed of interlocking, twenty-four (24) gauge, insulated, roll-formed, galvanized steel slats with baked-on prime paint and polyester top coat assembled together to form a water shedding surface on the weather side. Bottom of curtain shall be reinforced with two aluminum angles placed back-to-back. A compressible neoprene weather seal shall be provided on bottom of curtain. Vinyl weather stripping shall be provided at jambs. Curtain colors shall be selected by the GROUP's REPRESENTATIVE.
2. Where required, malleable iron windlocks shall be provided at ends of slats to engage lockbars in guides and lock the curtain.
3. Guides shall be built of minimum 3/16-inch-thick structural steel to form a slot of sufficient depth to retain the curtain in the guides against heavy wind pressure, and for doors requiring windlocks, guides must be provided with lockbars for windlocks. Guides shall be continuous from top to bottom and shall be anchored to the wall with 3/8-inch bolts at intervals not to exceed thirty-six (36) inches.
4. Top of guides shall be furnished with removable, bell-mouthed curtain guides and malleable iron curtain stops.

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B. Coil Barrel and Hood

1. The curtain shall be counterbalanced at each position in its vertical travel by helical torsion springs enclosed within the steel coil barrel. Springs shall be of oil-tempered steel, cold formed and heat treated. Springs shall be anchored to a single, solid torsion rod and shall be held in position by a common adjusting wheel accessible from the outside.
2. Coil barrel shall be designed so that deflection under load does not exceed 0.03-inch per foot of opening width. Ends of coil barrel shall be completely closed with heavy, cast iron plugs machined to fit inside of pipe. Coil barrel shall be supported on self-aligning, permanently lubricated and sealed ball bearings.
3. Coil brackets shall be of high-grade iron or steel designed to house ends of the coil and form an end closure support for the hood.
4. Coil shall be enclosed by a hood constructed of twenty-four (24) gauge galvanized steel. Hood shall have stiffening rolls at top and bottom edges and shall be adequately supported. An interior, neoprene hood baffle shall be furnished in the hood.

C. Motor Operator

1. Coiling door shall be motor operated.
2. Provide manufacturer's standard motor and accessories.
3. Provide standard interior control station with "OPEN," "CLOSE," and "STOP" push buttons.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Coiling doors shall be installed in accordance with the manufacturer's shop drawings.

3.02 SURFACE PREPARATION AND SHOP PAINTING

- A. All non-galvanized ferrous surfaces of door and guides shall be cleaned and shop primed.
- B. Color shall be as selected by the GROUP's REPRESENTATIVE.

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3.03 FIELD PAINTING

- A. Following installation, all exposed, non-galvanized ferrous surfaces shall be field primed and painted with Alkyd System Ferrous Metal Finish in accordance with the requirements of Section 09900 of these Technical Specifications.

3.04 INSPECTION AND TESTING

- A. After installation, the ability of the coiling door to operate properly and smoothly without jamming, excessive noise or excessive chain pull shall be demonstrated to the satisfaction of the OWNER's REPRESENTATIVE. CONTRACTOR shall, at the CONTRACTOR's own expense, adjust or modify the door as required to achieve satisfactory operation in the opinion of the OWNER's REPRESENTATIVE.

3.05 MANUFACTURER SERVICE

- A. During the installation work, an experienced field representative of the manufacturer shall be present to assist the CONTRACTOR and direct the installation of the coiling doors. Following installation, the manufacturer's representative shall provide the OWNER's REPRESENTATIVE with a written certification of proper installation.

3.06 CLEANING

- A. Prior to acceptance of the work of this Section, thoroughly clean all installed materials and related areas in accordance with manufacturer's guidelines and to satisfaction of the OWNER's REPRESENTATIVE.

*****END OF SECTION*****

SECTION 08610

WINDOWS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The work covered by this Section consists of providing all labor, equipment, and material required to furnish and install all windows and related work as described herein and/or shown on the Contract Drawings or required for a complete installation.

1.02 RELATED SECTIONS

- A. Section 13120 – Pre-Engineered Metal Buildings

1.03 SUBMITTALS

- A. CONTRACTOR shall submit proposed material shop drawings, catalog cut sheets, and/or other product literature for all specified windows.
- B. The submittal information required by this Section of the Technical Specifications shall be sufficient to indicate materials, opening dimensions, component dimensions, framed opening tolerances, affected related work, and installation requirements necessary for approval by the OWNER's REPRESENTATIVE. Provide anchorage and fasteners (hardware), glass, and internal drainage details.
- C. Submit in accordance with Section 01300 of these Technical Specifications

1.04 STORAGE AND PROTECTION

- A. Protect windows from damage during transportation and at the job site. Store windows at the site, under cover, on wood blocking or on suitable floors. After installation, protect windows from damage during subsequent construction activity. Damaged work will be rejected and shall be placed with new work.
- B. Protect factory-finished surfaces with strippable coating. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.

PART 2 – PRODUCTS

2.01 MATERIALS AND CONSTRUCTION

- A. Windows shall be vinyl-frame construction. Windows shall be Permashield as manufactured by Andersen or approved equal. The mention of manufacturer's name(s) in this Section is done to establish and/or describe the intended level of quality.
- B. Windows shall include insect screens consisting of formed aluminum frames with baked-on coating and shall be easily removable from window frame. Screens shall be complete with mesh fiberglass screen material.
- C. Windows shall have operating hardware to allow movement of window panes/lights for ventilation purposes.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. CONTRACTOR shall install window units in accordance with manufacturer's instructions. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier. Coordinate attachment and seal of perimeter air and vapor barrier materials.

3.02 CLEANING

- A. CONTRATOR shall remove protective material from factory-finished surfaces. Wash surfaces by method recommended and acceptable to sealant and window manufacturer; rinse and wipe surfaces clean. Remove excess sealant by moderate use of mineral spirits or other acceptable solvent.

*****END OF SECTION*****

SECTION 08710

FINISH HARDWARE

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The work covered by this Section consists of providing all labor, equipment and material required to construct and install all finishing hardware and related work as described herein, as shown on the Contract Drawings, and as otherwise required.

1.02 RELATED SECTIONS

- A. Section 08735 – Weather-Stripping and Thresholds

1.03 QUALIFICATIONS

- A. The hardware supplier must be an established firm dealing in contract finishing builder's hardware, with a sample room and adequate inventory. This supplier must be prepared to provide a competent representative to service hardware on the jobs as may be required. This hardware supplier shall be a regular franchised distributor for all hardware, materials and equipment required in this Section.

1.04 REGULATORY REQUIREMENTS

- A. CONTRACTOR shall conform to applicable state and local code for fire related door and frame requirements.

1.05 SUBMITTALS

- A. Shop drawings and engineering data submittals shall be made in accordance with the Specifications. A complete schedule of each item of hardware required for each door or item of equipment shall be submitted. List hardware item number, manufacturer, manufacturer's number or symbol and finish. Indicate locations and mounting heights of each type of hardware.
- B. CONTRACTOR shall submit complete manufacturing data as follows:
 - 1. Specifications and installation data on door hardware of all types.
 - 2. With shop drawings, a brochure showing and describing each type of hardware that is being supplied to the Project.

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- C. CONTRACTOR shall supply all necessary templates and template information to door and frame manufacturers in ample time to prevent delay to project.

1.06 STORAGE AND PROTECTION

- A. Provide adequate locked storage space for hardware before distribution and installation.
- B. Properly tag, index and file all keys as directed prior to turning over to the GROUP.
- C. Hardware shall be checked after delivery to the Project by the hardware supplier before it is installed.
- D. Package each item of hardware and each lock set separately in individual containers, complete with necessary screws, keys, instructions and installation template for spotting mortising tools. Match each container with item number corresponding to number shown on the CONTRACTOR's hardware schedule.

1.07 QUALITY ASSURANCE

- A. The manufacturer shall provide written certification to the OWNER's REPRESENTATIVE that all products furnished comply with all applicable requirements of these Specifications. The certification shall be project-specific, i.e., mentions the project by name, and shall be notarized.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The hardware manufacturer shall be an experienced, reputable firm with a full line of door hardware.
- B. Mortise locksets shall be UL listed, or approved equal.
- C. Butt hinges shall be manufactured by Hager, Stanley, Yale or Lawrence Brothers, or approved equal.
- D. Door closers shall be LCN 4010 Series, Sargeant 150 Series or Yale 3500 Series, or approved equal.
- E. All internal mechanisms of locksets and closers shall be corrosive resistant type.
- F. All finish hardware shall be U532D including hinges, locksets, push/pull, and closer covers.

2.02 MATERIALS AND CONSTRUCTION

- A. Keys and Keying: All locksets shall be master-keyed. Five (5) master keys shall be provided to the GROUP's REPRESENTATIVE, with five (5) copies of each key required for the work.
- B. Construction Keying: Furnish all locks and cylinders construction keyed. CONTRACTOR shall furnish six construction master keys. At completion of job, the insertion of permanent key shall void the construction master key.
- C. Mortise Locksets: Unless otherwise shown or specified, mortise locksets shall be heavy duty, mortise type conforming to Federal Specification FF-H-106, Type 86 and ANSI A156.2, Series 1000, Grade 1. Lockset shall have lever type, escutcheon, 2-piece, 5/8-inch throw antifriction latch bolt, 1-inch throw deadbolt, 6-pin brass tumbler lock mechanism, and curved lip strike conforming to ANSI A115.1. Lockset shall be UL listed.
- D. Butt Hinges: Unless otherwise specified, doors sixty (60) inches high and not over ninety (90) inches high shall receive three full mortise butt hinges. Doors over 90-inches-high but not over 120-inches-high shall receive four full mortise butt hinges. Hinges shall be of the stainless steel, two (2) race ball bearing type. Out-swinging exterior doors shall have non-removable pins. Minimum gauge of all hinges shall be 0.134-inch, unless indicated otherwise, with minimum size of 4-1/2 inches by 4-1/2 inches. Hinges shall be of a type and size to allow for proper door swing and clearance.
- E. Door Closers: Automatic door closers shall have full rack and pinion construction with heat-treated steel rack and pinion and cast iron or bronze hydraulic case. Closers shall have separate valves for adjustment of latching speed and closing speed, fifty (50) percent closing power spring adjustment, separate valve for adjustment of backcheck cushioning and tamperproof, rectangular, full metal cover. Backcheck shall be effective at approximately seventy (70) degrees for both regular and parallel arm applications. Closers shall be surface mounted and through bolted on the door and, whenever possible, shall be mounted on the room or interior side. Closers with parallel arms on exterior doors shall be the next larger size than normally used with the door. Closers on exterior doors shall have hold-open devices adjustable from eighty-five (85) through one-hundred-eighty (180) degrees. All door closers shall be furnished with a 5-year warranty from the manufacturer. Closers shall have finish to match other door hardware. Door closers shall be UL listed.
- F. Lockset Function: Unless otherwise shown or specified, lockset function shall be as follows on entrance doors: Latch bolt by both knobs; from outside by key. Outside knob locked or unlocked from inside by pushbuttons on mortise locks (Fed. 86A, ANSI F08). Dead bolt on mortise locks from outside by key or inside by turn lever.

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- G. Exit/Fire Devices: Roller strikes come with a plate underneath it, which prevents movement of the strike. The mechanism case shall be an aluminum extrusion and the center case shall be interchangeable with all functions. Push bar trim shall be stainless steel, mechanism end cap shall be zinc die cast – no plastic. Use only compression springs (no torsion springs). Trim shall be heavy-duty type, through-bolted with welded logs.
- H. Weather-stripping: All exterior doors shall be weather-stripped. Weather-Stripping shall be in accordance with the requirements of Section 08735 of these Technical Specifications.
- I. Thresholds: Thresholds shall be furnished under Section 08735 of these Technical Specifications.
- J. Finish: Unless otherwise shown or specified, all butt hinges, locksets, panic devices and flatware shall be stainless steel with US 32D finish. Cast items, such as stops, bumpers, flush bolts, etc., shall have US 26D dull chrome finish. Those items not available in US 32D or US 26D finish shall be aluminum or anodized aluminum.

2.03 HARDWARE SCHEDULE

Exterior Doors

- 1 1/2 pair hinges
- 1 lockset
- 1 closer
- 1 exit/fire device
- 1 weather-stripping (Section 08735)
- 1 threshold (Section 08735)

Interior Doors

- 1 1/2 pair hinges
- 1 lockset
- 1 closer (rated door only)

PART 3 – EXECUTION

3.01 LOCATION

- A. Before installation of any hardware, verify the positioning of each type of assembly. This will include the exact location of each element of hardware.
- B. Distances from the floor to centerline of each hardware item shall be as dictated by Code or as recommended by the hardware supplier.

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3.02 INSTALLATION

- A. Install hardware such that it is accurately fitted, securely applied and carefully adjusted in accordance with manufacturer's instructions. Use care not to damage other work when installing.
- B. When required, remove and replace doors so that door bottoms and tops may be painted.
- C. Remove all visible hardware before painting is begun and replace afterwards, prior to completion of building.
- D. CONTRACTOR shall protect all hardware during construction work and replace defective units with identical, new units.

3.03 CLEANING

- A. All materials shall be free from sand holes and other imperfections. Finish shall be as noted above. Protect all hardware during construction work and replace defective units. Clean and polish with clean cloth and leave in good operating condition.

*****END OF SECTION*****

SECTION 08735

WEATHER-STRIPPING AND THRESHOLDS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The work covered by this Section includes furnishing and installing thresholds and weather-stripping for all doors furnished under these Specifications as shown on the Contract Drawings or required for a complete installation. CONTRACTOR shall provide a “Competent Person” to implement, supervise and inspect all Work.

1.02 RELATED SECTIONS

- A. Section 08110 – Steel Doors and Frames
- B. Section 08331 – Overhead Coiling Doors
- C. Section 08710 – Finish Hardware

1.03 COORDINATION

- A. CONTRACTOR shall coordinate the work under this Section with work under Sections 08110, 08331, and 08710 of these Technical Specifications.

1.04 SUBMITTALS

- A. Submit complete shop drawings and engineering data in accordance with the requirements of these Technical Specifications.
- B. Submit samples (3-inch min. length) of all resilient weather-stripping materials.
- C. Submit in accordance with Section 01300 of these Technical Specifications.

1.05 QUALITY ASSURANCE

- A. The Manufacturer shall provide written certification to the GROUP's REPRESENTATIVE that all products furnished comply with all applicable requirements of these Technical Specifications. The certification shall be project-specific, i.e., mention the project by name and shall be notarized.

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PART 2 – PRODUCTS

2.01 THRESHOLDS

- A. Unless otherwise specified or shown, thresholds shall be of the interlocking type with serrated surface approximately 1/2 inch in height and five (5) inches in width of extruded aluminum alloy 6063-T5 with natural mill finish.
- B. All necessary screws and fasteners shall be furnished. Fasteners for aluminum thresholds shall be stainless steel.

2.02 WEATHER-STRIPPING

- A. All exterior hollow metal doors shall be weather-stripped as specified herein.
- B. Weather-stripping at lock-side jamb, hinge-side jamb and head shall be 3/16-inch by 1-inch closed cell neoprene held in place on the frame by an extruded aluminum housing having a minimum thickness of 0.094 inch and a clear, anodized finish. Housing shall be furnished with a simulated bronze finish on doors with brass finish hardware. Weather-stripping shall be equal to Reese No. D578, Zero No. 139 or National Guard No. 130NS.
- C. Unless otherwise shown, interlocking weather-stripping shall be provided by a heavy duty door hook. Door hook shall be equal to Reese No. TL4 or National Guard No. 83A.
- D. Aluminum extrusions shall be of aluminum alloy 6063-T5, anodized as specified above.
- E. Closed cell neoprene shall be closed cell, neoprene, sponge rubber conforming to Military Specification R6130, Type II, Grade C.
- F. All fasteners necessary for proper installation shall be provided and shall be brass or stainless steel.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Surfaces to receive work in this Section shall be smooth, even, sound, thoroughly clean, dry and free of defects, which would adversely affect application of this work. Surfaces, which do not meet the tolerances or quality imposed within the Technical Specifications, shall be repaired or replaced prior to initiating this work.

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- B. Install in strict accordance with shop drawings and the Manufacturer's printed instructions.
- C. Adjust interlocking weather-stripping for proper operation.
- D. Protect all work of this Section until all related Work is completed. Repair or replace damaged work with new at no additional cost to OWNER.

*****END OF SECTION*****

SECTION 09900

PAINTING

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. The work covered by this Section includes surface preparation and field application of paints and coatings.

1.02 SUBMITTALS

- A. Product Data: Provide data on all finishing products.
- B. Samples: Submit two (2) samples, illustrating range of colors and textures available for each surface finishing product scheduled.
- C. Manufacturer's Instructions: Indicate special surface preparation procedures, substrate conditions requiring special attention.
- D. Submit in accordance with Section 01300 of these Technical Specifications.

1.03 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum five (5) years documented experience.
- B. Applicator: Company specializing in performing the work of this Section with minimum five (5) years documented experience.

1.04 REGULATORY REQUIREMENTS

- A. Conform to applicable code for flame and smoke rating requirements for finishes.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle in accordance with manufacturer's guidelines. Store and protect from damage from weather and construction activity.
- B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

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- C. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- D. Store paint materials at minimum ambient temperature of forty-five (45) degrees Fahrenheit and a maximum of ninety (90) degrees Fahrenheit, in ventilated area, and as required by manufacturer's instructions.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- C. Minimum Application Temperatures for Latex Paints: forty-five (45) degrees Fahrenheit for interiors; fifty (50) degrees Fahrenheit for exterior; unless required otherwise by manufacturer's instructions.

1.07 EXTRA MATERIALS

- A. Provide to OWNER one extra, unopened gallon of each color, type, and surface texture.
- B. Label each extra and/or partially filled container with color, type, texture, and room locations, in addition to the Manufacturer's label.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Coatings: Ready mixed, except field-catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating; good flow and brushing properties; capable of drying or curing free of streaks or sags.
- B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.
- C. Patching Materials: Latex filler.
- D. Fastener Head Cover Materials: Latex filler.

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2.02 FINISHES

- A. Refer to schedule at end of Section for surface finish.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Plaster and Gypsum Wallboard: 12 percent.
 - 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 - 3. Interior Wood: 15 percent, measured in accordance with ASTM D2016.
 - 4. Exterior Wood: 15 percent, measured in accordance with ASTM D2016.
 - 5. Concrete Floors: 8 percent.

3.02 PREPARATION

- A. Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
- C. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- D. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt and rust. Where heavy coatings of scale are evident, remove by power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of

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phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

- E. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- F. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.
- G. Wood and Metal Doors Scheduled for Painting: Seal top and bottom edges with primer.

3.03 APPLICATION

- A. Apply products in accordance with Manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform finish.
- D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- E. Sand wood and metal lightly between coats to achieve required finish.
- F. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
- G. Allow applied coat to dry before next coat is applied.
- H. Prime concealed surfaces of interior and exterior woodwork with primer paint.

3.04 CLEANING

- A. Collect waste material, which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.05 SCHEDULE - EXTERIOR SURFACES

- A. Steel - Shop Primed: Doors and Frames
 - 1. Touch-up with zinc chromate primer.
 - 2. Two coats of alkyd enamel, gloss.

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3.06 SCHEDULE - INTERIOR SURFACES

A. Wood - Painted

1. One coat of latex prime sealer.
2. Two coats of latex enamel, semi-gloss.

B. Concrete, Concrete Block

1. One coat of block filler, sealer.
2. Two coats of latex semi-gloss, exposed areas only.

C. Steel - Unprimed

1. One coat of alkyd primer.
2. Two coats of alkyd enamel, gloss.

D. Steel - Primed

1. Touch-up with alkyd primer.
2. Two coats of alkyd enamel, gloss.

E. Gypsum Board

1. One coat of latex primer sealer.
2. Two coats of latex enamel, semi-gloss.

*****END OF SECTION*****

SECTION 11110

PNEUMATIC GROUNDWATER EXTRACTION PUMPS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. CONTRACTOR shall furnish and install a pneumatic groundwater extraction pump system including ten (10) groundwater extraction wells (EW-01 through EW-10). Each pump system, as shown on the Contract Drawings and described herein, shall consist of, but is not limited to, the following:
 - 1. Controllor-less pneumatic auto pumps and check valves;
 - 2. Pump cycle counter;
 - 3. Compressed air supply, vent and discharge hoses;
 - 4. Stainless-steel barb fitting kits for hoses;
 - 4. Tank full shut-off unit (TFSO) and sensor; and
 - 5. Pump support cable/rope and clamps.
- B. All materials to be installed in the extraction well vaults shall be constructed of material compatible with the groundwater to be extracted.
- C. CONTRACTOR shall comply with all applicable codes, ordinances, rules, regulations and laws of local, municipal, State and Federal authorities having jurisdiction. CONTRACTOR shall also comply with all applicable health and safety regulations as required by OSHA and in accordance with the CONTRACTOR's Health and Safety Plan.

1.02 RELATED SECTIONS

- A. Section 11322 – Air Compressor Equipment
- B. Section 13280 – Leachate Holding Tank

1.03 SUBMITTALS

- A. Shop Drawings/Cut Sheets:
 - 1. CONTRACTOR shall submit the following information to the REMEDIAL DESIGNER for favorable review, prior to purchase. Compressor data shall include, but is not limited to, the following:
 - a. Performance curves;
 - b. Air consumption curves;
 - c. Dimensional drawings;
 - d. Materials of construction;
 - e. Pressure and vacuum ratings of all equipment;
 - f. Pressure gauges;

- g. Hoses and barb-connections; and
- h. Pump support clamps.

B. Samples:

- 1. Not required.

C. Operation and Maintenance Manuals:

- 1. CONTRACTOR shall furnish three (3) copies of all associated manufacturer-supplied operation and maintenance manuals.

- D. CONTRACTOR shall submit shop drawings/cut sheets and operation and maintenance manuals, in accordance with Section 01300 of these Technical Specifications.

1.04 QUALITY ASSURANCE

- A. The pump system shall be provided by a single manufacturer.
- B. Manufacturer of pumps and pump system shall provide, at a minimum, a one (1) year warranty on all products.
- C. CONTRACTOR shall provide, at the CONTRACTOR's expense, a pump system representative at the Site to inspect installation, start-up, and testing, and to instruct the GROUP'S personnel on the operation of the air-operated pump systems. The representative shall be on-Site conducting these activities for a minimum of two business days (16 hours).

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. QED Autopump: Model LDAP-4B; Bottom Loading, or approved equal.

2.02 PNEUMATIC AUTO PUMP

- A. Each pump shall be capable of meeting the following pump performance and compressed air consumption requirements at forty (40) psig air pressure inlet:

Discharge Head (ft)	GPM	Air Consumption (SCFM)
38	3	1.8

CONTRACTOR is responsible for verifying final pump performance requirements based on final installed elevation of groundwater holding tank.

B. Each pneumatic auto pump shall meet the following specifications:

1. Type: air-displacement with screened bottom inlet;
2. Uses compressed air only when discharging fluids;
3. Functions under positive or negative (rate to full vacuum) pressure environments;
4. Does not require clean, dry air to function properly; and
5. All pump parts constructed of stainless steel, with seat, seals, and balls constructed of Teflon, or approved equal.

2.03 AIR REGULATOR AND CONTROLS UNIT

A. The system compressed air and tank full shutoff are regulated and controlled by the dual-sensor tank-full shut-off system in a wall mounted control panel provided by QED or approved equal. This control panel is to be located in the new storage building. The controls shall include the following:

1. Pressure regulator adjustable from 0-125 psi and rated for 250 psi, with ability to adjust supply air pressure to the pump;
2. Pump cycle counter for each pump; and
3. Air pressure gauge on regulator inlet and outlet.

2.04 HOSE AND HARDWARE

A. Hose and hardware shall have the following specifications:

1. Pump Air Supply:

Hose:	Pump Supply Air
Working Pressure:	300 psig
Fittings:	Stainless steel (S.S.) barb-connections with S.S. clamps, or approved equal
Size/Color:	1/2-inch I.D. Green hose, or approved equal
Materials of Construction:	Nitrile, or approved equal
Length 1:	Provide 20 feet (min.) for each pump up to the air manifold.
Length 2:	Provide 1,800 feet (min.) to air compressor manifold. Runs of hose between extraction wells shall be continuous and contain no splices.

2. Pump Groundwater Discharge:

Hose:	Discharge
Working Pressure:	300 psig
Fittings:	Stainless steel barb-connections with S.S. clamps, or approved equal
Size/Color:	1-inch I.D. Black hose, or approved equal

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Materials of Construction:	Nitrile, or approved equal
Length 1:	Provide 20 feet (min.) for each well up to discharge manifold.
Length 2:	Provide 1,800 feet (min.) to groundwater storage tank. Runs of hose between extraction wells shall be continuous and contain no splices.

3. Exhaust and TFSO sensing:

Hose:	Exhaust and TFSO sensing
Working Pressure:	300 psig
Fittings:	Stainless steel barb-connections with S.S. clamps, or approved equal
Size:	1/2" I.D. Blue hose, or approved equal
Materials of Construction:	Nitrile, or approved equal
Length 1:	Provide 20 feet (min.) for each pump.
Length 2:	Provide 50 feet (min.) for TFSO sensor.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. CONTRACTOR shall install equipment per manufacturer's recommendations and instructions.
- B. Runs of hose between extraction wells shall be continuous and contain no splices. A minimum of two (2) clamps per barbed connection is required.

3.02 TESTING

- A. CONTRACTOR shall start and test the pneumatic pumping system per the manufacture's recommendations and instructions. Additionally, testing shall include pressurizing the system to supply air to the pneumatic pumps in the groundwater extraction wells.
- B. The system shall be tested for a minimum of two (2) hours in presence of QUALITY ASSURANCE OFFICER (QAO) and REMEDIAL DESIGNER. CONTRACTOR shall repeat testing procedures as the pneumatic pumps are placed into service

END OF SECTION

SECTION 11372

AIR COMPRESSOR EQUIPMENT

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. CONTRACTOR shall furnish and install a complete and operable air compressor system to be located in the new storage building. The compressor system, as shown on the Contract Drawings and described herein, shall consist of, but is not limited to, the following:

1. One (1) electrically operated air compressor;
2. One (1) steel air receiver tank;
3. Air regulator, controls and gauges;
4. Intake filters; and
5. Interconnecting piping, valves and gauges between the air compressor and air receiver tank.

- B. All components of the air compressor system shall be compatible with the following operating conditions:

Ambient Temperature: 10°F - 110°F
Relative Humidity: 0% - 100%

- C. CONTRACTOR shall comply with all applicable codes, ordinances, rules, regulations and laws of local, municipal, State and Federal authorities having jurisdiction. CONTRACTOR shall also comply with all applicable health and safety regulations as required by OSHA and in accordance with the CONTRACTOR's Health and Safety Plan.

1.02 RELATED SECTIONS

- A. Section 11110 – Pneumatic Groundwater Extraction Pumps

1.03 SUBMITTALS

- A. Shop Drawings/Cut Sheets:

1. CONTRACTOR shall submit the following information to the DESIGNER for approval prior to purchase. Compressor system data shall include, but is not limited to, the following:
 - a. Compressor performance data, including pressure and flow;
 - b. Compressor motor data, including horsepower, rpms, and other relevant data;

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- c. Dimensional data; and
 - d. Pressure and vacuum ratings of all equipment.
- 2. CONTRACTOR shall submit product data on ancillary equipment, including:
 - a. Air regulator;
 - b. Pressure gauges (including ranges);
 - c. Inlet particulate filter;
 - d. Valves; and
 - e. Piping.
- B. Operation and Maintenance Manuals:
 - 1. CONTRACTOR shall furnish three (3) copies of all associated manufacturer-supplied operation and maintenance manuals.
- C. CONTRACTOR shall submit shop drawings/cut sheets and operation and maintenance manuals in accordance with Section 01300 of these Technical Specifications.

1.04 SYSTEM DESIGN

- A. Air compressor shall be sized to provide 2.3 scfm at forty (40) psig at a 100% duty cycle.

1.05 QUALITY ASSURANCE

- A. The entire compressor system shall be provided by a single manufacturer.
- B. Manufacturer of compressor system shall provide, at a minimum, a one (1) year warranty on all products.

1.06 OPERATION AND MAINTENANCE DATA

- A. CONTRACTOR shall submit under provisions of Section 01700 of these Technical Specifications.
- B. Maintenance data submitted shall include installation instructions, spare parts lists, and exploded assembly views.

PART 2 – PRODUCTS

2.01 AIR COMPRESSOR

- A. The air compressor system shall be capable of delivering 2.3 scfm at a minimum of forty (40) psig. Compressor shall be pressure-controlled to maintain a downstream pressure. Pressure set-point shall be field adjustable.

- B. The air compressor shall operate as required, and meet the following minimum specifications:

1. Compressor type: electric;
2. Motor rating: 115 Volt, 1 phase, 60 Hz;
3. Running motor: 0.68 HP;
4. Free air: 3.20 CFM at 90 psig (min.);
5. Free air: 2.30 CFM at 40 psig (min.);
6. Gauge shall indicate discharge air pressure;
7. Adjustable low-pressure start and high-pressure shutdown compressor switches; and
8. Air inlet filter.

2.02 COMPRESSED AIR RECEIVER

- A. The compressed air receiver shall meet the following requirements at a minimum:

1. Capacity of 3 gallons;
2. Maximum operating pressure of 135 psi;
3. Pressure relief valve;
4. 1/4" NPT outlet connection;
5. Corrosion-resistant external coatings; and
6. Dedicated pressure gauge.

2.03. AIR FILTER

- A. Provide an air inlet filter, which meets the Manufacturer's specifications.

2.04 VALVES

- A: Safety relief valve shall be provided by the air compressor system manufacturer, and these valves shall be set at the maximum safe operating pressure of the air compressor.

2.05 SPARE PARTS

CONTRACTOR shall provide the following spare parts:

- A. One (1) air compressor; and
B. Two (2) air compressor inlet filters.

PART 3 – EXECUTION

- 3.01 The air compressor system shall include, but not limited to, an air compressor, compressed air receiver, and filter, and shall be installed per manufacturer's recommendations and instructions.
- 3.02 CONTRACTOR shall install a 24-hour timer on the electrical circuit for the air compressor system. Timer shall be capable of turning the compressor system On/Off at pre-selected times. Timer shall be equipped with a manual On/Off override, which does not interfere with the timer.
- 3.03 CONTRACTOR shall start and test the air compressor system per the manufactures recommendations. Additionally, testing shall include pressurizing the system to supply air to the pneumatic pumps in the groundwater extraction wells.
- 3.04 The specified air compressor system shall be tested for a minimum of two (2) hour in the presence of the QUALITY ASSURANCE OFFICER (QAO) and REMEDIAL DESIGNER. CONTRACTOR shall repeat testing procedures, as the pneumatic pumps are placed into service.

*****END OF SECTION*****

SECTION 13120

PRE-ENGINEERED METAL BUILDINGS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. CONTRACTOR shall furnish all labor, materials, equipment, tools and appurtenances required to complete the work of furnishing and erecting a pre-engineered metal building including insulated metals walls and roof, soffits and trim, flashings and closures, bathroom, doors and hardware, wall louvers, and wall/roof penetrations.
- B. Some of the contents of this Section may not be directly applicable to this work, but are included for completeness and reference.
- C. CONTRACTOR shall locate all existing active and abandoned utilities and structures in designated Work areas prior to commencing any construction activities. The CONTRACTOR shall also protect from damage those utilities and structures which are to remain in-place.
- D. CONTRACTOR shall obtain all associated permits and certificate, and comply with applicable codes, ordinances, rules, regulations and laws of local, State, or Federal authorities having jurisdiction.

1.02 RELATED SECTIONS

- A. Section 01564 – Health and Safety
- B. Section 03300 – Cast-In-Place Concrete
- C. Section 03200 – Concrete Reinforcement Section
- D. Section 08110 – Steel Doors and Frames
- E. Section 08331 – Overhead Coiling Doors
- F. Section 08610 – Wood Windows
- G. Section 08710 – Finish Hardware
- H. Section 08735 – Weather-Stripping and Thresholds
- I. Section 09900 – Painting

1.03 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

- A. AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318 Building Code Requirements for Reinforced Concrete

- B. AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
 - AISC S335 Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design
- C. AMERICAN IRON AND STEEL INSTITUTE (AISI)
 - AISI Specification for the Design of Cold-Formed Steel Structural Members
- D. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - ASTM A 36 Structural Steel
 - ASTM A 53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
 - ASTM A 446/A 446M Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
 - ASTM A 570/A 570M Steel Sheet and Strip, Carbon Hot-Rolled Structural Quality
- E. AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
 - ASCE 7 Minimum Design Loads for Buildings and Other Surfaces
- F. INTERNATIONAL CODE COUNCIL, INC. (ICC)
 - IBC International Building Code/2000 New Jersey
 - IMC International Mechanical Code
 - IFGC International Fuel Gas Code
- G. ILLUMINATING ENGINEERING SOCIETY (IES)
 - IES Lighting Handbook
- H. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
 - NEC National Electrical Code (NFPA 70)
- I. NEW JERSEY ADMINISTRATIVE CODE
 - NJAC Edition and Supplements
- J. METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)
 - MBMA Metal Building Systems Manual
- K. UNDERWRITERS LABORATORIES, INC. (UL)

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UL 580	Test for Wind-uplift Resistance of Roof Assemblies
UL 674	Standard for Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 698	Standard for Industrial Control Equipment For Use In Hazardous (Classified) Locations
UL 886	Standard for Outlet Boxes and Fittings for Use In Hazardous (Classified) Locations

1.04 QUALITY ASSURANCE

- A. CONTRACTOR shall perform work in accordance with MBMA publication "Metal Building Systems Manual."

1.05 GENERAL

- A. Enclosure shall be a standard product of a manufacturer regularly engaged in the manufacture of product and shall essentially duplicate items that have been in use for at least two (2) years prior to bid opening. Metal building shall have vertical walls and gable roofs. Roof slope shall be 1V:12H (minimum); 3V:12H (maximum).
- B. Building dimensions shall be as standard with the manufacturer, but not less than those indicated on the Contract Drawings. Frame and covering may be marked and prepunched to receive fasteners, or the drilling of holes for fasteners may be performed in the field. The completed building shall meet all specified design requirements and be free of excessive noise from wind-induced vibrations under the weather conditions ordinarily encountered at the location where the building is erected. Roof deck assemblies shall be Class 90 as defined in UL 580.
- C. CONTRACTOR shall furnish the concrete foundations, as necessary, for the pre-engineered buildings and aboveground leachate holding tank (LHT), including column footings, grade beams, curbs, etc., and including all exterior concrete work associated with the buildings. CONTRACTOR shall saw cut or remove the existing floor slab and perimeter wall and interior spread footings, as necessary and required, to install the requisite foundation systems for the new pre-engineered metal building. Floor slab shall be replaced or repaired, as required, to maintain original grades. CONTRACTOR may elect to: a) demolish, remove and dispose off-Site all existing floor slabs and perimeter wall and interior spread footing foundations; b) place structural fill, as necessary; and c) construct new foundation elements to support the specified pre-engineered metal structure.
- D. CONTRACTOR shall design and construct the specified pre-engineer metal building such that its interior finished floor elevations are at or above elevation El. +7.5 feet (NAVD88).
- E. CONTRACTOR shall design and provide spill prevention containment barriers around the specified leachate holding tank, which resides within the pre-engineered

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metal building. In addition, the volume of open air space circumscribed by these containment barriers shall be equal to or greater than five-thousand (5,000) gallons. Invert elevations within these containment barriers shall coincide with the approximate existing floor slab elevations. CONTACTOR shall design and install raised (i.e., elevated) piers and/or platforms to support the specified leachate holding tank, and raise the level of the leachate holding tank such that its invert is at or above elevation El. +8.0 feet (NAVD88).

- F. CONTRACTOR shall establish and provide all necessary utility (i.e., electric, water, and sanitary sewer) connection to the specified pre-engineered metal building.
- G. All materials and equipment installed within the specified pre-engineered metal building shall be positioned such that they reside at or above elevation El. +8.0 feet (NAVD88).

1.06 DESIGN REQUIREMENTS

- A. The procedures for developing the design loads and load combinations shall be in accordance with the IBC Code. Design of structural members shall be in accordance with MBMA publication "Metal Building Systems Manual."
- C. Structural steel members shall be designed in accordance with AISC S335. Structural cold-formed steel framing members shall be designed in accordance with AISI publication "Specification for the Design of Cold-Formed Steel Structural Steel."
- D. Except as otherwise specified, steel covering shall be designed in accordance with AISI publication "Specification for the Design of Cold-Formed Steel Structural Members." Maximum wind load deflection for wall panels and the maximum live deflection for roof panels shall not exceed 1/180th of the span between supports. Maximum deflections shall be based on sheets continuous across two or more supports with sheets unfastened and fully free to deflect.
- E. Louvers shall be fixed-blade type to be rainproof, and to resist vibration when air is passed at the velocity of one-thousand (1,000) cubic feet per minute through the net free area and as specified in section sheet metalwork.
- F. Roof ventilators shall be as specified in the Contract Drawings.
- G. Electrical service for the building shall consist of a 480-volt, three phase, three wire feeder into a 60-amp MCB, a welding outlet rated at 30 amps and a transformer (480 volt, 3 phase, delta primary - 120/208 volt, 3 phase, 4 wire "Y" secondary) feeding a 125 amp frame panel with a 125 amp MCB with 42 spaces. CONTRACTOR shall provide breakers, as required. Transformer may be located outside, if preferred.

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- H. Fluorescent lighting with energy-saving lamps and high-power-factor (HPF) energy saving ballasts shall be provided. Illumination levels shall be in accordance with the IES Lighting Handbook. Local switching for all interior lighting shall be provided. Emergency battery pack lights and exit signs shall be provided. Exterior lighting shall be provided, using high-pressure sodium fixtures at entrance way. CONTRACTOR shall furnish and install lamps for all lighting fixtures as required.
- J. Wiring equipment and fittings shall be explosion-proof in conformance with the applicable requirements of UL 674, UL 698, and UL 886 for Class I, Division 1, Group C and D hazardous locations. Electrical equipment shall conform to the requirements of NFPA 70.
- K. CONTRACTOR shall provide electric heaters and controls to maintain minimum internal temperatures of fifty-five (55) degrees Fahrenheit year-round.

1.07 SUBMITTALS

CONTRACTOR shall submit the following to the GROUP's REPRESENTATIVE for favorable review and approval:

- A. Building Systems: Shop drawings shall consist of catalog cuts; design and erection drawings; complete design analysis for building; shop painting and finishing specifications; instruction manuals; and other data as necessary to clearly describe design, materials, sizes, layouts, construction details, fasteners, and erection. For all metal building designs except those programmed on a computer, the shop drawings shall be accompanied by engineering design calculations for structural and covering components. For computer-programmed designs, shop drawings shall be accompanied by stress values and a certificate, signed by a registered professional engineer licensed and registered in the State of New Jersey, stating the design criteria and procedures used and attesting to the adequacy and accuracy of the design.
- B. Certificates: CONTRACTOR shall furnish certificates of compliance stating that the metal building furnished for this project complies with the material and fabrication requirements of this section.
- C. Colors: Exterior color(s) shall be selected by the GROUP's REPRESENTATIVE. CONTRACTOR shall submit color selections of all interior and exterior components.
- D. Submit in accordance with Section 01300 of these Technical Specifications.

1.08 DELIVERY AND STORAGE

- A. Materials shall be delivered to the Site in dry and undamaged conditions and stored out of contact with the ground. Materials other than framing and structural members shall be covered with weather-tight coverings and kept dry. Storage

accommodations for roof and wall covering shall provide good air circulation and protection from surface staining.

1.09 ROOFING AND SIDING PANEL FINISH WARRANTY

- A. CONTRACTOR shall furnish the roofing and siding panel manufacturer's written warranty covering failure of the factory-applied exterior finish on metal wall and roof panels within the warranty period. This warranty shall be in addition to and not a limitation of other rights the GROUP may have against the CONTRACTOR under the contract documents.
- B. Warranty period for factory-applied exterior finished on wall and roof panels is twenty (20) years after the date of substantial completion.

1.10 EXTRA MATERIALS

- A. Maintenance Stock: CONTRACTOR shall furnish at least five (5) percent excess over required amount of nuts, bolts, screw, washers and other required fasteners for each metal building. These materials shall be packed in cartons labeled to identify the contents and store on-Site, where indicated by the GROUP's REPRESENTATIVE.

PART 2 – PRODUCTS

2.01 BUILDING COMPONENTS

- A. The size and weight of prefabricated components shall permit easy handling in the field; the maximum size and weight of any component shall be suitable for transportation by commercial carrier. Each piece or part of the assembly shall be clearly and legibly marked to correspond with the shop drawings.
- B. Steel 1/8 inch or more in thickness shall conform to ASTM A36. Uncoated steel less than 1/8 inch in thickness shall conform to ASTM A570. Galvanized steel shall conform to ASTM A446, G 90 coating designation, 0.045 minimum thicknesses. Structural pipe shall conform to ASTM A53. Shop connections for steel shall conform to the AISC S335, or AISI publication "Specification for the Design of Cold-Formed Steel Structural Members," as applicable. Erection bolts and anchor bolts shall be of standard sizes and types. Holes for the bolt shall be made in the shop, prior to assembly of structural members in the field.
- C. Flashing, trim, metal closure strips, caps, and similar metal accessories shall be not less than the minimum thicknesses specified for covering. Accessories shall be compatible with the system furnished. Exposed metal accessories shall have a factory finish to match the building finish. Molded closure strips shall be closed-cell or solid-cell neoprene, premolded to match configuration of the covering and shall be absorb or retain water.

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- D. Fasteners for wall and roof panels shall be zinc-coated steel, corrosion-resisting steel, or nylon capped steel, of type and size specified below or as otherwise approved for the applicable requirements. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be gasketed or have gasketed washers on the exterior side of the covering to waterproof the fastener penetration. Washer material shall be compatible with the covering and have a minimum diameter of 3/8 inch for structural connections; the gasketed portion of fasteners or washers shall be neoprene 1/8 inch thick. Exposed wall fasteners shall be color-finished or provided with plastic color caps to match the covering. Nonpenetrating fastener system using concealed clips shall be the manufacturer's standard for the system provided.
- E. Louvers shall be fabricated of zinc-coated steel and shall be furnished with bird screens.
- F. Materials other than roof and wall covering shall be of thickness necessary to conform to design requirements and these specifications. The following table lists the minimum thicknesses that will be allowed:

<u>Items</u>	<u>Minimum-Uncoated Thickness</u>
Light gauge steel - structural members other than wall and roof covering	0.048 inch
Gable and eave trim, fascia closure strips, rake flashing, coping, and liner panels steel	0.018 inch
Louvers - steel	0.048 inch
Gutters - steel	22 gauge
Downspouts - steel	26 gauge

- H. Doors shall comply with the Section 08110 and 08331 of these Technical Specifications.
- I. Windows shall comply with Section 08610 of these Technical Specifications.
- J. Sealant shall be silicone sealant, polyisobutyl type. Concealed sealant may be nonhardening type.
- K. Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.02 SHOP PAINTING

- A. Ferrous surfaces shall be cleaned of oil, grease, loose rust, loose mill scale and other foreign substances and shall be shop-primed. Primer coating shall be in accordance with whichever is more stringent: Section 09900 of these Technical Specifications, or

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the manufacturer's standard system. Gutters, downspouts, louvers shall be shop-painted in the indicated color.

2.03 LAVATORY REQUIREMENTS

- A. The building shall contain a lavatory that includes all typical appliances and complies with the "Americans with Disabilities Act" (ADA), as follows:
 - a. Wall-mounted flush toilet, with extend bowl and seat.
 - b. Wall-mounted cast iron sink with white porcelain finish. The sink bowl area shall be minimum 18-inches-wide by 14-inches-deep.
 - c. Point-of-use water heater mounted to the wall. Minimum requirements of the water heater are 2.5 gallons and 1,300 watts.
 - d. Toilet paper holder, paper towel dispenser, soap dispenser and two (2) grab bars.

2.04 EMERGENCY WASH REQUIREMENTS

- A. The building shall be equipped with a combination emergency drench shower/eye wash station plumbed from a potable water supply. Unit shall meet requirements of ANSI Standard Z358.1-1998.

PART 3 – EXECUTION

3.01 ERECTION

- A. Erection shall be as specified in accordance with the approved erection instructions and drawings. Dissimilar materials which are not compatible when in contact with each other shall be insulated from each other by means of gaskets or insulating compounds. Improper or mislocated drill holes shall be plugged with an oversize screw fastener and gasketed washer; however, sheets with an excess of such holes in critical locations shall not be used. Exposed surfaces shall be kept clean and free from sealant, metal cuttings and other foreign materials. Stained, discolored or damaged sheets shall be removed from the site.
- B. Wall covering shall be applied with the longitudinal configurations in the vertical position. Roof covering shall be applied with the longitudinal configurations in the direction of the roof slope. Accessories shall be fastened into framing members, except as otherwise approved. Closure strips shall be provided as indicated and where necessary to provide weather-tight construction.
- C. Except for self-framing buildings, end laps shall be made over framing members with fasteners into framing members approximately two (2) inches from the end of

the overlapping sheet. Side laps shall be laid away from the prevailing winds. Side lap distances, end lap distances, joint sealing and the spacing and fastening of fasteners shall be in accordance with the manufacturer's standard practice insofar as the maximum spacings specified are not exceeded and provided such standard practice will result in a structure that will be free from water leaks and meet design requirements. Spacing for fasteners shall present an orderly appearance and shall not exceed: eight (8) inches on center at end laps of covering, twelve (12) inches on center at connection of coverings, and eighteen (18) inches on center at side laps of wall coverings, except when otherwise approved. Side laps and end laps of roof and wall covering and joints at accessories shall be sealed. Method of applying joint sealant shall conform to the manufacturer's recommendation. Fasteners shall be installed in straight lines within a tolerance of 1/2 inch in the length of a bay. Fasteners shall be driven normal to the surface and to a uniform depth to properly seat the gasketed washers.

- D. Concealed Fastener Wall Panels: Panels shall be fastened to framing members with concealed fastening clips or other concealed devices standard with the manufacturer. Spacing of fastening clips and fasteners shall be in accordance with the manufacturer's written instructions insofar as the maximum fastener spacings specified are not exceeded and provided such standard practice will result in a structure that will be free from water leaks and meet design requirements. Spacing of fasteners and anchor clips along the panel interlocking ribs shall not exceed twelve (12) inches on center except when otherwise approved. Fasteners shall not puncture covering sheets except as approved for flashing, closures and trim; exposed fasteners shall be installed in straight lines. Interlocking ribs shall be sealed with factory-applied sealant. Joint accessories shall be sealed.
- E. Concealed Clip, Standing Seam Roof Panels: Roof panels shall be fastened to framing members with concealed fastening clips or other concealed devices standard with the manufacturer. Spacing of clips and fasteners shall be in accordance with the manufacturer's written instructions. End laps, when approved by REMEDIAL DESIGNER, shall be made framing members. Fasteners shall not puncture covering sheets except as approved for flashing, closures and trim. Exposed fasteners shall be installed in straight lines. Interlocking ribs shall be sealed if standard with or recommended by the manufacturer. End laps of covering sheets and joints at accessories shall be sealed. Seams between roof panels shall be mechanically field-formed with a seamer at the project site.
- F. Louvers and ventilators shall be rigidly attached to the supporting construction in a manner to assure a rain-tight installation.
- G. Doors and windows, including frames and hardware, shall be securely anchored to the supporting construction, shall be installed plumb and true and shall be adjusted as necessary to provide proper operation. All joints at doors and windows shall be sealed to provide weather-tight construction and in accordance with the manufacturer's recommendations.

3.02 FIELD PAINTING

- A. Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire-brushed and touched up with the same material used for the shop coat. Shop-primed ferrous surfaces exposed on the outside of the building and all shop-primed surfaces of doors and windows shall be painted with two coats of an approved exterior enamel. Factory color-finished surfaces shall be touched up as necessary with the manufacturer's recommended touch-up paint.

*****END OF SECTION*****

SECTION 13280

LEACHATE HOLDING TANK

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. CONTRACTOR shall furnish all labor, materials, equipment, tools and appurtenances required to complete the work of furnishing and installing one (1) 5,000-gallon, double-walled, aboveground Leachate Holding Tank (LHT). These requirements include, but are not limited to, fittings, flanged nozzles, lifting lugs, monitor fittings, manways, saddles, tie-down straps, and anchoring provisions as recommended by the manufacturer. Some of the contents of this Section may not be directly applicable to this Work, but are included for completeness and reference.
- B. CONTRACTOR shall comply with all applicable codes, ordinances, rules, regulations and laws of local, municipal, state, and federal authorities having jurisdiction. CONTRACTOR shall also comply with all applicable health and safety regulations as required by OSHA and in accordance with CONTRACTOR's Health and Safety Plan.

1.02 REFERENCED PUBLICATIONS

The latest edition of the publications listed below form a part of these specifications:

- A. American Society for Testing and Materials (ASTM):
 - ASTM A 53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
 - ASTM A 194 Nuts, Grade 8
 - ASTM A 234 Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
 - ASTM A 307 Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
 - ASTM A 733 Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
 - ASTM F 436 Hardened Steel Washers
- B. American Society of Mechanical Engineers (ASME):
 - ASME B16.5 Pipe Flanges and Flanged Fittings
 - ASME B16.11 Forged Fittings, Socket Welding and Threaded
 - ASME B16.21 Nonmetallic Flat Gaskets for Pipe Flanges
 - ASME B16.34 Valves – Flanged, Threaded, and Welded End

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ASME B16.3 Chemical Plant and Petroleum Refinery Piping

C. American Welding Society (AWS):

AWS A5.1 Carbon Steel Electrodes for Shielded Metal Arc Welding

AWS A5.4 Stainless Steel Electrodes for Shielded Metal Arc Welding

D. Manufacturers Standardization Society of the Valve and Fitting Industry (MSS):

MSS SP-58 Pipe Hangers and Support – Materials, Design and
Manufacture

MSS SP-69 Pipe Hangers and Support – Selection and Application

E. National Fire Protection Association (NFPA):

NFPA 30 Flammable and Combustible Code

NFPA 70 National Electrical Code

F. Steel Tank Institute (STI):

STI F921 Standard for Aboveground Tanks with Integral Secondary
Containment

G. Underwriters Laboratories (UL):

UL 142 Aboveground Tank Specifications

UL 698 Industrial Control Equipment for Use in Hazardous
(Classified) Locations

UL 913 Intrinsically Safe Apparatus and Associated Apparatus for Use
in Class I, II, and III, Divisions I Hazardous (Classified)
Locations

1.03 SUBMITTALS

- A. CONTRACTOR shall submit manufacturer's standard catalog data prior to the purchase and or installation of each particular component. The data shall be highlighted to indicate brand name, model number, size options, performance charts and curves, etc. in sufficient detail to demonstrate compliance with contract documents on all parts and equipment including holding tank, holding tank components, accessories, piping components, and monitoring accessories.
- B. CONTRACTOR shall submit copies of all required federal, state, and local permits and certificates, as necessary.
- C. CONTRACTOR shall submit the manufacturer's installation instructions and procedures for the holding tank, holding tank components, and accessories.

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- D. A minimum of fourteen (14) days prior to delivery, CONTRACTOR shall submit results of factory testing containing the information described below:
1. Date of tests that were performed;
 2. A list of equipment used with calibration certifications;
 3. Copy of measurements taken;
 4. Parameters to be verified;
 5. Condition specified for each parameter;
 6. Inspection results, signed, dated, and certified by CONTRACTOR. The certification shall state that the required procedures were accomplished and that the procedures were conducted in compliance with contract documents; and
 7. Descriptions of any adjustments performed.

1.04 OPERATION AND MAINTENANCE DATA

- A. CONTRACTOR shall provide three (3) sets of operation and maintenance (O&M) manuals for the specified double-walled, aboveground LHT. These O&M manuals shall include, at a minimum, all drawings, equipment lists with manufacturer's name and model number, equipment manuals, recommended spare parts inventory, detailed description of controls' sequence of operation, and troubleshooting guide.

1.05 QUALITY ASSURANCE

- A. To ensure a proper operating system, CONTRACTOR shall provide, at a minimum, a one (1) year warranty on all products.

PART 2 – PRODUCTS

2.01 STANDARD PRODUCTS

- A. Materials and equipment shall be standard products of a manufacturer regularly engaged in manufacturing of similar products and shall essentially duplicate items that have been in use for at least two (2) years prior to bid opening.
- B. Tanks shall carry a thirty (30) year limited warranty.
- C. System components shall be environmentally suitable for the indicated product and environment.

2.02 NAMEPLATES

- A. Holding tank, holding tank components, and accessories within this specification shall have an attached nameplate to list the manufacturer's name, address, component type or style, model or serial number, catalog number, and capacity or size. Plates shall be durable and legible throughout equipment life and made

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of anodized aluminum. The tank shall have the STI and UL labels affixed. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.03 ELECTRICAL WORK

- A. Wiring equipment and fittings shall be explosion-proof in conformance with the applicable requirements of UL 674, UL 698, and UL 886 for Class I, Division 1, Group C and D hazardous locations. Electrical equipment shall conform to the requirements of NFPA 70.

2.04 MATERIALS

- A. Those tank or tank systems that may come in contact with groundwater shall be steel, stainless steel, epoxy-coated steel, or plastic. No non-compatible material or metals shall be used in tanks where contact with groundwater could occur.
- B. Gaskets shall be factory cut from one (1) piece of material and be resistant to the effects of groundwater. Gaskets shall be Nitrile Butadiene (Buna-N) or Acrylonitrile Butadiene Rubber (NBR), or approved alternate.
- C. Bolts shall be in accordance with ASTM A 193, Grade 8.
- D. Nuts shall be in accordance with ASTM A 194, Grade 8.
- E. Washers shall be in accordance with ASTM F 436, flat circular stainless steel. Washers shall be provided under each bolt head on nut.
- F. Concrete anchor bolts shall be Group II, type A class 2 in accordance with ASTM A 307. Drilled in-place concrete anchorage system shall be stainless steel and must be approved by REMEDIAL DESIGNER prior to anchors being installed.

2.05 LEACHATE HOLDING TANK (LHT)

- A. The LHT shall be designed, constructed, and labeled in accordance with Underwriters Laboratories' UL 142 and conform to STI F921 standards. The LHT shall be constructed of steel conforming to NFPA 30.
- B. The LHT shall visibly display the Underwriters Laboratories' label. The holding tank and support system shall be delivered as a complete UL listed unit.
- C. Primary Tank:
 - 1. The tank capacity shall be a minimum of 5,000 gallons.
 - 2. The tank shall be a nominal 96 inches in diameter.
 - 3. The tank shall have an interior coating that is resistant to corrosion by contaminated groundwater.

- D. Secondary Containment Tank (Outer Tank):
1. Sensor and monitoring system indicating the presence of liquid within the cavity between the tanks (interstitial cavity) shall be provided.
- E. The holding tank and supports shall meet all Uniform Building Codes. Tank supports shall provide minimum of twelve inches (12") of clearance underneath the tank. In addition, tank shall be installed such that its lowest invert level is at or above elevation El. +8.0 feet (NAVD88). Additionally, the tank shall be anchored/secured to resist flotation.
- F. The entire interior of the steel holding tank shall be given an interior protective coating. The interior coating shall be a two-coat epoxy coating system consisting of a prime coat and a finish coat. Total dry film thickness shall be not less than 6 mils (0.15 mm).
- G. The tank exterior shall be painted with an epoxy primer coat and a white polyurethane finishing coating. Painting shall be factory-applied over an SSPC-6 commercial sandblast surface preparation. Surfaces shall be free of all dust, oil, and grease.
- H. A tank-full prevention unit ("tank-full level") shall be placed within the tank interior and be an integral part of the tank filling operation. The unit shall be a TSFO Shut-off system. The overfill valve shall completely stop the flow of liquid into the tank when the liquid level rises above 90 percent of the tank capacity.
- I. The tank shall be vented as per NFPA, including emergency venting.
- J. The tank system shall be furnished with calibrated charts showing the liquid contents in gallons for each inch (2.54 cm) of tank depth. Two (2) reproductions of the gauge chart shall be enclosed in plastic and bound into hardback binders. Two (2) manual gauges (stick gauges) graduated in feet, inches, and eighths of an inch shall be provided. Stick gauges shall be constructed of wood and treated after graduating to prevent swelling or damage from the condensate liquids. A PVC pipe holder for a manual gauge shall be provided, mounted vertically adjacent to the tank unit. The port for manual measurement shall include a gauge hatch that easily opens for stick measurements.
- K. The system shall contain a tank liquid level gauge. Gauge shall indicate depth in inches or gallons over the tank full usable liquid level range and be accurate to within 0.25 inches.
- L. The system shall contain an air pressure switch to monitor for low system compressed air pressure. The unit shall provide local indication of system air pressure. The switch shall be integrated into the remote monitoring unit (auto-dialer).
- M. The system shall contain a "two float" level sensor that will activate at two distinct levels – "high" level (80% full) and "high-high" level (85% full).

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1. The “high” level switch should energize an indicator lamp to alert personnel of the tank’s level status. Lamp (light) may be a panel-mounted or stand-alone wall unit.
 2. The “high-high” level switch shall notify the auto-dialer and also prevent the air compressor from operating.
 3. Floats shall be resistant to corrosion by contaminated groundwater.
- N. The system shall be supplied with an auto-dialer to notify of system alarm conditions. The auto-dialer shall be capable of dialing a minimum of four (4) programmed numbers. The auto-dialer shall be capable of accepting eight (8) universal inputs, – i.e., temperature, dry contact, 4-20mA analog-type signals.
1. The following inputs shall be integrated into the auto-dialer: high-high level, tank leak detector, and low system air pressure switch.
 2. The auto-dialer shall prevent the air compressor from operating when tank leak detection input is activated.
- O. The LHT unit shall be grounded by use of grounding cable and clamp connection per UL and NFPA standards and codes.

PART 3 – EXECUTION

3.01 GENERAL

- A. The LHT unit shall be handled with extreme care to prevent damage during shipment, handling, and storage. Tank openings shall be covered to prevent the entry of dirt or water. Tank shall be vented at all times.
- B. The tank shall be installed in accordance with the manufacturer’s installation instructions, contract documents, and UL and NFPA standards and codes.
- C. Coating damage shall be repaired by as per manufacturer’s written instructions.
- D. Tank shall be labeled with 2-inch-high lettering as “NON-FLAMMABLE” and include all required Hazard Identification labeling and placarding, as required by federal, state and local rules, regulations, and laws.

3.02 TESTING

- A. After installation, the tank shall be pressure-tested with air at five (5) psig. Pressure shall be held for a minimum of two (2) hours with no measurable loss in pressure. Testing shall be performed in the presence of QUALITY ASSURANCE OFFICER (QAO) and REMEDIAL DESIGNER.
- B. CONTRACTOR shall repair all leaks at no additional expense to the GROUP. Tank manufacturer shall certify all tank repairs. CONTRACTOR shall provide copies of certified test results.

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3.03 INSULATION AND HEAT TRACING

A. Not applicable

*****END OF SECTION*****

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. This Section of the Technical Specifications and the accompanying Contract Drawings are intended to cover the provisions for all labor, material, and equipment by trade necessary for the required electrical work.
- B. Furnish and install elements for complete functioning systems, services, and equipment, as specified by the Contract documents, including but not limited to:
 - 1. Secure, pay for, and file all permits, licenses and applications for services. Performance of all work shall be in accordance with local and other authorities having jurisdiction. Provide drawings for GROUP's approval and as required to secure permits and install all the materials and equipment;
 - 2. Furnish and install new electrical service including coordination with the utility company for provision of a meter socket, new service entrance conduit, wire, disconnect, main panel and ground bonding. Electrical service for the building shall consist of a 480-volt, 3-phase, 3-wire above or underground feeders into a 60-amp MCB, a welding outlet rated at thirty (30) amps and a transformer (480-volt, 3-phase, delta primary - 120/208 volt, 3-phase, 4-wire "Y" secondary) feeding a one-hundred-twenty-five (125) amp frame panel with a one-hundred-twenty-five (125) amp MCB with forty-two (42) spaces. CONTRACTOR shall provide all breakers, as required. Transformer may be located outside, if preferred;
 - 3. Wiring equipment and fittings shall be explosion-proof in conformance with the applicable requirements of UL 674, UL 698, and UL 886 for Class I, Division 1, Group C and D hazardous locations. Electrical equipment shall conform to the requirements of NFPA 70;
 - 4. Furnish and install new electrical distribution wiring and conduit, as required;
 - 5. Furnish and install all disconnects for equipment and power wire all motors, as required;
 - 6. Furnish and install all lighting fixtures and receptacles, as required;
 - 7. Furnish and install all transformers, as required;

8. Start-up, cleaning, testing and adjustments; and
9. Operating instructions and equipment manuals.

1.02 CODES AND REGULATIONS

- A. Comply with the latest editions of following works, including all supplements thereto and any other authority having jurisdiction within requirements of this specification.
 1. Local Codes.
 2. New Jersey Labor and Industry.
 3. National Electrical Code as amended (NFPA No. 70, 71, 72, 72C).
 4. O.S.H.A.
 5. BOCA Code.
 6. International Building Code (IBC)
- B. Whenever specifications require materials, workmanship, arrangement or construction of higher standard or larger size than is required by codes and regulations, the Technical Specifications shall take precedence.
- C. Should there be direct conflict between above-mentioned regulations and Technical Specifications, regulations shall govern.
- D. All electrical materials and equipment shall bear label of Underwriter's Laboratories; listed by them in their list of electrical fittings; and approved by them for purpose for which they are to be used, unless material and equipment is of type for which Underwriter's Laboratories do not list or provide label service.

1.03 UNDERWRITERS' INSPECTION AND APPROVAL

- A. Obtain and pay for necessary Certificate of Inspection, and Approval, from Local Electrical Inspection Bureau. Obtain both rough and final certificates. Present Certificates of Final Inspection, and Approval, together with final request for payment. No final inspection or approval of payment will be made without this Certificate.

1.04 INSTALLATION – GENERAL

- A. Make no major deviations from indicated or hereinafter described method of circuit or feeder groups, except in cases where unforeseen obstructions are encountered.
- B. Examine and study Structural and all Mechanical drawings; particularly note wall construction and become thoroughly acquainted with conditions affecting installation of all conduits, wiring and other electrical work.

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- C. Cutting of chases in unplastered concrete block or masonry partitions not permitted. Run vertical conduit runs in voids of wall, or special built-up units where provided. Cooperate with CONTRACTOR to accomplish this method of construction; ascertain exact locations of all chases prior to installation of conduit.
- D. Install feeder and circuit conduit and wire and empty conduits from and between all points of origin to and between all various classes of outlets or apparatus of every description, as indicated on drawings and/or hereinafter described.

1.05 RACEWAYS

- A. General use rigid galvanized steel conduit for all raceways, in masonry construction, or any exposed raceways in the equipment bay.
- B. Thin wall electrical metallic tubing (EMT) may be used in partitions and other furred spaces where not passing thru or buried in concrete and where not in wet locations or other locations prohibited by Code. Use compression type fittings only. No set screw fittings will be allowed.
- C. Run all raceways concealed, except in following areas:
 - 1. Equipment Bay.
- D. Type NM cable may be used above drop ceilings or in stud walls provided that grommets, bushings, or protective plates are used. Properly support all raceways. Do not rest raceway on drop ceiling, ductwork or other equipment.
- E. Conduit: as manufactured by Triangle, Republic, Pittsburgh Walker or General Cable.
- F. Do not install conduit which has been crushed or deformed in any way.
- G. Cap or plug conduit ends as soon as possible after installation and let remain so until just before installation of wires. Ream all conduits and remove burrs. Double lock nut and bush conduit where entering boxes, fittings or cabinets, except at threaded hubs. All conduits shall enter outlet boxes or cabinets squarely. Where bushings larger than 1" are required, use insulating type. Use flexible metal conduits for short lengths only, such as at motor terminals. Min. size conduit permitted: 3/4" except for starter or contactor coil control or pilot light circuits, where 1/2" will be permitted.
- H. Circuit Conduit Runs: Install in ceiling construction, floors or in walls and partitions during construction. In hung or furred ceilings, install square bends, junction or pull boxes as necessary to suit structural or field conditions. Installation in any dirt fill not permitted.

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- I. Exposed Conduit Construction: Install all exposed conduit in neat workmanlike fashion, after piping, ductwork, etc. of other trades is in position, using square bends. Use access fittings at all external elbow locations.
- J. Recessed Fixture Connections:
 - 1. Stationary Fixtures
 - a. Extend conduit to within one (1) foot of fixture location, install outlet box or pull box secured to construction, and provide flexible metallic tubing (Greenfield) lead to fixture not less than 4-foot-long, nor more than 6-foot-long. Use only approved fixture wire in flexible conduit. Locate outlet box so accessible when fixture is removed.
- K. Motor Terminal Connections: Make flexible connections at motor terminal boxes with flexible metallic conduit and connectors.
- L. Conduit Condensation: Swab entire conduit system free of condensation prior to installation of wire.

1.06 CONDUIT FITTINGS

- A. Provide suitable hot-dip galvanized steel or malleable iron fittings as required, as manufactured by Appleton, Crouse-Hinds, O.Z. Electric, Steel City, or Thomas Betts.
- B. Where conduits are installed exposed, use only hot-dip galvanized malleable iron fittings, for elbows, unions, receptacle and switch boxes; type FS or FD, manufactured by Appleton or Crouse-Hinds.
- C. Where condulets are required provide hot-dip galvanized malleable iron boxes fittings; Appleton "Threaded Unilets," or approved equal.
- D. Insulated Bushings: Plastic, fiber, or bakelite insulating rings molded into hot-dip galvanized malleable iron threaded bushings.

1.07 EXPANSION JOINTS

- A. Where conduits cross building construction joints or expansion joints, provide vapor-tight, weatherproof conduit expansion joints as manufactured by Crouse-Hinds or approved equal.

1.08 FLEXIBLE METAL CONDUIT AND FITTINGS

- A. For general use: Flexible conduit of type known as "Greenfield" cable.

- B. For motor connections, and use in damp locations: Oil and moisture tight galvanized steel flexible conduit with copper bonding conductor and synthetic rubber jacket; "Sealtight" as manufactured by Americal Brass Co., or approved equal, complete with ground bushings.
- C. Fittings: Appleton Series "AT" fitters, unions, elbows, gaskets and locknuts, or approved equal.

1.09 RECEPTACLES

- A. All standard receptacles shall be Duplex 120V 20A grounding type receptacles. Bathroom receptacles shall be Duplex 120V 20A and have ground-fault circuit-interrupter protection.

1.10 CABLE TROUGHS, JUNCTION AND PULL BOXES

- A. Where required for proper execution of work, provide all cable troughs, junction and/or pull boxes, each of proper size, gauge (not less than #12 12 ga) and type for location and use, complete with screw covers of size convenient and adequate for proper installation of required number of cable or wires; to conform with code requirements.

1.11 OUTLET BOXES

- A. Except as otherwise specified, provide stamped steel boxes of proper size gauge and type for each location and use; securely fastened in place not supported by conduit. Provide fixture studs in boxes, where required.
- B. Manufacturers: Appleton, Crouse-Hinds, Steel City, Rayco or J.R. Richards.

1.12 HANGERS, SUPPORTS, ETC.

- A. Use only special devices specifically designed and manufacturing for hanging and support of conduit, cable, etc., as manufactured by Appleton Electric Co., Steel City Electric Co., Thomas & Betts Co., or F&S Mfg. Corp., Unistrut, or equal.
- B. For support of all conduit, cable, cable trays, cable troughs, junction and pull boxes, outlet boxes, etc., which are not built in walls or floors, provide approved types of wall brackets, ceiling trapeze hangers, pipe straps hangers, clevis hangers or side-lock hangers.
- C. Support horizontal and vertical conduit runs of conduit at intervals required by Code. Do not use hangers accommodating piping of other trades.
- D. Secure all hangers and supports by means of inserts to concrete slabs; "C" clamps to structural steel members; toggle bolts in hollow masonry units; rawl

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plugs in concrete, brick, or solid masonry walls; machine screws on metal surfaces or wood screws on wood construction. Nails: not permitted.

1.13 WIRE

- A. All wiring branch circuits: Type THHN. All wiring installed in Mechanical/Electrical Rooms: Type THWN. Feeder wire Type THW.
- B. All wiring: Copper, having 600 volt insulation. Wiring for light or power: not smaller than #12 AWG. Wiring for coil control circuits only, or for pilot lights only: may be #14 AWG. Remote control, signaling & power limited circuits may be run without conduit in ceiling plenum provided it is Teflon or kynar insulated and jacketed and is in compliance with U.L. Subject 13 and the National Electrical Code Article 725-2(b), Article 760-4(d), Article 800-3(d).
- C. All wire shall be copper. Aluminum wire will not be allowed.
- D. Identify all main feeders and branch circuits by color coded wire as required by Code.
- E. Wire Manufacturer: Phelps-Dodge, General Cable, Triangle, Crescent Insulated Wire and Cable Company or Essex Wire & Cable Co.
- F. Do not use block and tackle or other mechanical means of pulling conductors in raceways. Use only powdered soapstone as lubricant.
- G. On all circuit wiring throughout, allow sufficient slack at splices and outlets to permit connections without straining generally not less than four (4) inches in junction or outlet boxes and ten (10) inches in ducts, troughs or pull boxes.
- H. Splicing Terminal and Tap Connections: Make joints and splices only in wire troughs, gutters, pull boxes, junction boxes and outlet boxes in mechanically and electrically secure manner using only approved solderless connectors, lugs, etc., as approved by Code.
- I. Make all terminal connections of mains and feeder circuits using approved high pressure clamping type solderless connectors; "Lock-Tite" as manufactured by Thomas & Betts Co., or equal, as manufactured by O.Z. Electric Manufacturing Co.
- J. Make all branch circuit terminal connections, splices, etc., using only 3M Stotchlok electrical spring connectors and insulate with Scotch or other approved plastic electrical tape, or by using nylon "Wing Nut Connectors" with internal spring tension grip manufactured by Ideal Industries, Inc., insulated with approved plastic electrical tape.
- K. Ordinary wire nuts or porcelain type connectors: not acceptable.

- L. Properly identify and tag all mains, feeders, and branch circuits in all pull boxes, gutters, troughs, junction boxes, etc., in which they connect. Similarly, identify and tag wires where two or more circuits run to or pass through same outlet or junction box.
- M. Install tags in all pull boxes, troughs, junction and outlet boxes, and in gutter of all panels, as wires are pulled.
- N. All tags: Flame resistant linen, wired on, marked in indelible ink; in each case, bearing designation of feeder or circuit.

1.14 GROUNDING

- A. In accordance with requirements of local Utility Company and National Electrical Code:
 - 1. Ground and bond service and circuits in accordance with Article 250 of NEC.
 - 2. Adequately ground fluorescent lighting fixtures to insure proper starting of rapid start units.
 - 3. Adequately ground all isolated conduit systems for low tension work.

1.15 NAMEPLATES

- A. Provide nameplates for all control equipment, engraved brass or engraved laminoid; riveted in place.

1.16 BRANCH CIRCUITS

- A. CONTRACTOR to provide drawings indicating conduit and circuit home run layout for various branch circuits and equipment.

1.17 DEVICE PLATES

- A. Type 430 stainless steel.
- B. Plates installed on exposed boxes: cadmium plated steel with rounded edges.
- C. Provide engraved or marked metal plates for special outlets or switches, where suitable legend is available. Otherwise provide suitable engraved laminoid nameplates.

1.18 DISCONNECTS

- A. Unless otherwise required by Code, provide non-fuses heavy duty disconnects where and of size required, as with 2 or 3 pole as required, manufactured by Square D Company, General Electric or Westinghouse.
- B. Where located outside building, provide weatherproof type in cast iron enclosures, as manufactured by Russell & Stoll or Crouse-Hinds. Wire disconnects with blades hinged on load side, so blades are dead with switch open.

1.19 FEEDERS

- A. Properly identify all feeder wires. Any high leg phase 'B' shall be orange coated.

1.20 METERING EQUIPMENT

- A. CONTRACTOR shall comply with all requirements of the utility co. for provisions of meter sockets, current transformers or primary metering locations.

1.21 FUSES

- A. Upon completion of job, provide fuses in all devices where required, plus one (1) complete spare set. Deliver to the GROUP's REPRESENTATIVE and obtain written receipt for same. Cartridge fuses: of Fusetron type, manufactured by Bussman Mfg. Co., or similar as manufactured by Shawmut or Economy.

1.22 SPECIAL INSTRUCTIONS

- A. Upon completion of installation, manufacturer for each piece of equipment shall provide complete set of shop drawings, operated instructions, maintenance data, parts list, etc. to the GROUP's REPRESENTATIVE. Neatly secure these within binder.
- B. CONTRACTOR shall submit Manufacturer operation and maintenance manuals to the GROUP's REPRESENTATIVE, and Manufacturer shall check its equipment for wiring, rotation and proper operation, and demonstrate its operation, maintenance care and emergency procedures to the GROUP's REPRESENTATIVE's satisfaction.

1.23 FINAL TESTS

- A. Prior to the turning over of work as complete unit, test all wiring installed under this contract for proper connections, short circuits and grounds. Conduct tests with aid of suitable testing instruments, and in presence of GROUP's REPRESENTATIVE.

1.24 FLASHING

- A. Flash all conduit penetrations through roof with 6# sheet lead or 16 oz. copper soldered on all seams and joints; attached by approved adapter which will seal top of flashing of conduit.

1.25 ACCESS DOORS

- A. Group together concealed boxes, controls or other electrical equipment requiring access, concealed in hung ceilings, walls, and furred spaces, to reduce number and size of access doors, but with all equipment freely accessible of maintenance.

1.26 LIGHTING

- A. Furnish and install lighting in accordance with the following schedule:

<u>Personnel Doors:</u>	Wall-mount lumnares, 70 watt HPS with photocells, shall be provided on the outside walls above all personnel doors.
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<u>Outside Walls:</u>	Wall-mount luminaires, 150 watt HPS with photocells, shall be provided and installed outside of the building to illuminate the surrounding area. Minimum one fixture per wall.
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- B. Fluorescent lighting with energy saving lamps and high power factor energy saving ballast shall be provided. Illumination levels, coefficient of utilization and iso-footcandle distribution shall be in accordance with the IES Lighting Handbook. Local switching for all interior lights shall be provided.
- C. Emergency battery packs lights and exit signs shall be provided and circuited from the unswitched leg of the local lighting circuits.

1.27 TEMPORARY POWER AND LIGHT

- A. Furnish install and maintain a temporary service and wiring system from start to completion of construction. This shall cover the standard work day in all trades. Any CONTRACTOR requiring service at times other than those falling within the standard work day shall make his own arrangements therefore directly with Electrical CONTRACTOR.
- B. Furnish, install, operate, protect and maintain all service entrance, switches and other required entrance devices, feeder cables, protective switches, disconnects, panelboards, etc., necessary to extend and maintain temporary electric service for light and power during construction.

Revision 0

- C. Furnish and install two (2) weatherproof sockets for lighting outlets (120 volts each) every 30 ft. on centers in both directions where area is more than forty (40) feet wide throughout each building area, at stair landings, and at 16A-12 such other locations and with such spacings and lamp wattage as will comply with all safety requirements for access to and egress from building and its components. Extend and relocate as necessary the temporary lighting as construction work progresses, as directed by CONTRACTOR.
- D. Provide 200A single phase 120/240 volt and 200A 3 phase 240 volt service for all trades as required.
- E. Extend and relocate as necessary to avoid conflict or interference with work of any trade, the temporary power services as the construction work progresses, as directed by CONTRACTOR to provide power outlets at convenient locations so that fifty (50) foot extension cords will reach all work.
- F. Provide all safety lighting of barricades, passageways, halls, stairs and rooms in which light is required, to permit free access to premises at all times.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

*****END OF SECTION*****

APPENDIX H

CONSTRUCTION QUALITY ASSURANCE PLAN (CQAP)

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**CONSTRUCTION QUALITY ASSURANCE PLAN
OPERABLE UNIT-2 (OU-2)
216 PATERSON PLANK RD. SUPERFUND SITE
CARLSTADT, NJ**

Prepared for:

216 Paterson Plank Road Cooperating PRP Group

Prepared by:

Golder Associates Inc.
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Mt. Laurel, NJ 08054

May 2007

Project No.: 943-6222

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1.0 INTRODUCTION

1.1 Purpose and Scope

This Construction Quality Assurance Plan (CQAP) has been prepared by Golder Associates Inc. (Golder Associates) on behalf of the 216 Paterson Plank Road Cooperating PRP Group for the 216 Paterson Plank Road Superfund Site (Site) in Carlstadt, Bergen County, New Jersey. The purpose of this CQAP is to describe the quality assurance program that will be implemented during remediation activities associated with Operable Unit-2 (OU-2) in order to document that construction is completed in accordance with the intent of the Contract Drawings and Technical Specifications (hereinafter referred to as the Contract Documents). These activities include in situ treatment of the "hot spot", replacement of the sheet pile wall along Peach Island Creek, installation of a new groundwater extraction system, installation of a cap, and decommissioning of the interim remedy.

This CQAP describes the following elements:

- Responsibilities and authorities of all organizations and key personnel involved in the design and construction of the Remedial Action;
- Protocols for sampling and testing used to monitor construction;
- Identification of construction quality assurance (CQA) sampling; and,
- Reporting requirements for CQA activities including summary reports, inspection data sheets, problem identification and corrective measures reports, design acceptance reports, and final documentation. In addition, provisions for final storage of all records are specified.

This CQAP addresses construction quality assurance (CQA), which differs from construction quality control (CQC). In general, CQA refers to measures taken by an independent third party hired by the owner, in this case the Group, to assess whether the Remedial Action Contractor (Contractor) is in compliance with the plans and specifications for a project. CQC refers to measures taken by the Contractor to determine compliance with the requirements for materials and workmanship, as stated in the plans and specifications for the project. This CQAP is independent of CQC programs conducted by manufacturers and the Contractor and its subcontractors, which are described in the Technical Specifications.

This CQAP addresses the construction of the landfill cap, in situ treatment of the “hot spot”, streambank enhancements along Peach Island Creek, and upgrading the existing groundwater recovery system. Specifically, this CQAP addresses the preparation of the soil subgrade, the geosynthetic components of the cap system, the cover soil layer placed directly above the geosynthetic cap, stormwater management features, installation of a new sheet pile wall, and the extraction system wells and piping, including associated penetrations through the geosynthetic cap, verification that in situ “hot spot” treatment meets the treatment specifications, and demolition and decommissioning of the on site building and tank, and the current extraction system.

Details of materials, construction requirements, and procedures are included in the Technical Specifications, which are referenced by this CQAP.

1.2 Construction Quality Assurance Program

The CQA program is a planned system of activities that provides confirmation and documentation that a project is constructed in accordance with the intent of the Contract Documents. It includes inspections, verifications, audits, and evaluations of materials and workmanship necessary to determine and document the quality of the constructed work.

The basic components of the CQA program are:

- Preparation of a CQA Plan;
- Pre-construction review of project components;
- Conformance testing of geosynthetic and soil materials;
- Confirming and documenting survey control of final grades;
- Confirming and documenting testing of soil components during placement and compaction;
- Confirming and documenting construction of stormwater management features;
- Confirming and documenting construction of extraction system, piezometers, system controls and the sheet pile wall;
- Confirming and documenting demolition of building and tank, and decommissioning of current extraction system;

- Confirming and documenting proper completion of in situ “hot spot” treatment;
- Preparation of daily CQA reports;
- Review of technical and laboratory data;
- Final walk over and favorable review of the completed work; and,
- Preparation and submittal of a Final Record Documentation Report.

These CQAP guidelines provide for qualified personnel to monitor the progress and quality of construction. This program is intended to provide an objective overview of construction progress and identify potential deficiencies or problem areas during construction. The CQA program can also assist the Contractor in completing the project more efficiently by requiring compliance with the Contract Documents before the project proceeds to the extent where substantial work may have to be redone in order to correct a defect.

The CQAP identifies the personnel involved in CQA, and describes roles and responsibilities of the associated parties, QA reporting and record storage requirements. The CQAP also calls for a narrative describing construction, test results, and record drawings to be compiled into a Final Record Documentation Report signed by a Professional Engineer, registered in the State of New Jersey, which certifies that the portions of construction covered by the CQAP were completed in general conformance with the Contract Drawings, Technical Specifications, and approved modifications.

1.3 Project Documents

The following Project Documents were utilized for the preparation of this CQAP:

- “Preliminary (35%) Design Report” prepared by Golder Associates dated December 2005;
- Technical Specifications prepared for the Pre-Final (95%) Design Report by Golder Associates, dated October 2006; and,
- Design Drawings prepared for the Pre-Final (95%) Design Report by Golder Associates, dated October 2006.

2.0 PROJECT TEAM ORGANIZATION AND RESPONSIBILITIES

This section describes the organization and individual responsibilities during the implementation of the Remedy.

2.1 216 Paterson Plank Road Cooperating PRP Group

The Group is responsible for the overall implementation of the OU-2 Remedy described in the Pre-Final Design Report, including in situ treatment of the “hot spot”, streambank enhancements along Peach Island Creek, installation of a cap and replacement of the groundwater extraction system. The Group must comply with the requirements of the United States Environmental Protection Agency (USEPA) and demonstrate, by submission of CQA documentation, that the construction was performed as specified in the design. The Group will retain design, CQA, and construction organizations to accomplish the work and will have the authority to hire and fire these organizations. The Group also has the authority to accept or reject CQA plans, reports, and recommendations of the Quality Assurance Officer (QAO), and the materials and workmanship of the Contractor or their subcontractor(s).

2.2 Regulatory Agency

The USEPA is overseeing the completion of the landfill closure through the CERCLA program. It is the responsibility of the USEPA to review the Group’s plans for compliance with the regulatory requirements for this Site. The USEPA also has the authority to review all CQA documentation during or after construction to confirm that procedures outlined in this CQAP were followed, and that the construction was performed as specified in the design. These activities may involve on-site inspections or testing independent of the CQA program.

2.3 Group’s Representative

The Group’s Representative, or Representatives, is (are) directly responsible for the construction contract administration and for the management of this project for the Group. The Group’s Representative acts as a liaison and is in direct communication with the QAO, the Contractor, and subcontractors. General responsibilities of the Group’s Representative will include:

- Prepare an agenda for, preside at, and record project meeting minutes, including pre-construction and regular (i.e. weekly or as otherwise specified) progress meetings, substantial completion, or other meetings, as necessary;
- Monitor and coordinate the Contractor's work in relation to the schedule and conformance to the Contract Documents;
- Document that the required quality control (QC) testing has been performed in accordance with the Technical Specifications and report data to the Remedial Designer and QAO;
- Receive and review shop drawings and other material submittals from the Contractor and submit to the Remedial Designer for review. Coordinate with the Contractor to incorporate the Remedial Designer review comments;
- Schedule and coordinate CQA monitoring activities with the QAO;
- Coordinate any proposed substantive changes with the Remedial Designer, QAO, and Contractor;
- Coordinate any design clarifications or interpretations with the Remedial Designer and Contractor;
- Prepare periodic construction progress reports for distribution to the project team; and,
- Maintain on-site project record drawings and project files for storing of originals or copies of reports generated during construction.

2.4 Remedial Action Contractor

During the bidding process, the Group will select a qualified Remedial Action Contractor (Contractor) to undertake the types of construction activities to be implemented.

The Contractor will assign a Project Superintendent as the responsible person in charge of all aspects of the project. The Project Superintendent will have a background in engineering or construction management with experience in construction and contract administration. The Contractor will be responsible for constructing the work in accordance with the Contract Documents and implementation of the Health and Safety Plan.

The Contractor may engage various subcontractors to implement certain specialized portions of the work, such as, the geosynthetics installations and in situ “hot spot” treatment. The subcontractors will provide a field supervisor who will report directly to the Contractor Project Superintendent.

Upon completion of the project, the Contractor will provide record drawings to the Group’s Representative, Remedial Designer, and QAO for review.

2.5 Remedial Designer

The responsibilities of the Remedial Designer during implementation of the Remedy include the following:

- Review all proposed design and specification changes;
- Provide clarifications to the Contract Drawings and Technical Specifications, as necessary;
- Review submittals required by the Contract Drawings and Technical Specifications, including quality control tests; and,
- Participate in the pre-construction, substantial completion, and regular progress meetings to review construction activities and conformance with the intent of the remedial design.

Design and specification changes will be transmitted through the Remedial Designer for review and approval. The Remedial Designer will evaluate proposed materials and construction changes during construction for compliance with the intent of the Contract Drawings and Technical Specifications.

2.6 Quality Assurance Officer

The QAO will be responsible for overseeing and implementing this CQAP. The QAO will perform the CQA tasks required by this CQAP, and will confirm and document that the project construction has been completed in general conformance with the Contract Documents. The QAO will have the authority to reject materials and workmanship provided by the Contractor that are not in compliance with the Contract Documents. Responsibilities of the QAO for construction activities identified in this CQAP include the following:

- Review of the Contract Drawings, Technical Specifications, and related workplans and submittals to verify compliance with CQAP requirements;

- Work with the Group's Representative to review construction activities with the Contractor;
- Attend regular (e.g., weekly) project status meetings;
- Coordinate and schedule CQA testing with construction activities;
- Observe the CQC operations performed by the Contractor and its subcontractors;
- Review, in conjunction with the Remedial Designer and the Group's Representative, corrective measures to be implemented during construction when deviations from the CQAP occur;
- Observe CQC activities to help ensure that testing and documentation are complete, accurate and in general accordance with the Contract Documents;
- Evaluate the soils, geosynthetics, and other testing laboratories for the project;
- Observe and document placement and compaction of fill and backfill;
- Observe and document geosynthetic material placement, non-destructive and destructive seam testing, and seaming and repair operations;
- Observe and document sample collection following in situ "hot spot" treatment;
- Observe and document completion of the streambank enhancements, including installation of the new sheet pile wall;
- Observe and document installation of the enhanced groundwater extraction system and controls;
- Observe and document demolition of on site building and storage tank, and decommissioning of current extraction system;
- Work with the Group's Representative to determine that testing equipment used and tests performed are in accordance with the Technical Specifications and industry standards;
- Observe, document, and report on CQC tests;
- Report any identified deficiencies, not satisfactorily corrected by the Contractor, to the Group's Representative and Remedial Designer;
- Prepare daily CQA reports;
- Maintain an on-site project file for storing the originals or copies of all CQC reports and CQA test data sheets and reports generated during construction;

- Verify performance of as-built surveying by the Contractor in accordance with the Contract Documents; and,
- Prepare the Final Record Documentation Report at the completion of the project.

3.0 CONSTRUCTION ACTIVITIES

The following is a brief discussion of the Contractor's major remedial construction activities to be monitored by the QAO.

3.1 Earthwork

Earthwork activities include:

- Clearing and grubbing of the existing vegetation on the Site;
- Regrading of the landfill to provide minimum slopes;
- Placement of a grading layer in the cap area;
- Preparation and maintenance of the subgrade prior to geosynthetics installation;
- Placement of protective soil layer cover and vegetative support layer over the geosynthetics;
- Placement of riprap and coarse aggregate;
- Installation of surface water management structures, and;
- Completion of a site access road.

3.2 Geosynthetics

Geosynthetics installation activities include:

- Installation and seaming of the geosynthetic clay liner (GCL), geocomposite drainage layer, and geomembrane components of the cap;
- Installation of "boot" seals around geomembrane penetrations for the groundwater extraction system and other penetrations; and
- Installation and seaming of geotextile components of the cap and surface water management features.

3.3 Enhanced Groundwater Extraction System

Enhanced groundwater extraction system activities include:

- Drilling activities for installation of the new groundwater extraction system, including extraction wells and piezometers and control systems;
- Demolition of building currently on site;
- Construction of a pre-fabricated building and new tank on the slab from the demolished building; and,
- Decommissioning and dismantling the current groundwater extraction system including all above ground pipes, the above ground storage tank and control system.

3.4 In Situ "Hot Spot" Treatment

In situ treatment of the "hot spot" will include:

- Completion of the field verification program establishing rates for in situ air stripping (ISAS) and in situ stabilization (ISS) advancement / penetration, ISAS mixing times, and quality control testing requirements;
- Air stripping by mixing of soil while injecting air to remove VOCs,
- In situ solidification / stabilization using a cement / lime mixture; and,
- Verification that VOC removal meets requirements.

3.5 Streambank Enhancements

Streambank enhancements will include:

- Installation of a new sheet pile wall;
- Removal of fill material between the new and old sheet piles walls; and,
- Removal of the old sheet pile wall and H-buttresses at low water level of Peach Island Creek.

3.6 Miscellaneous

In addition to the activities described above, additional miscellaneous activities are also required, including:

- Installation of new fencing and gates;
- Establishment of permanent vegetation on the completed landfill cap and other areas disturbed by construction activities; and,
- Installation of stormwater management features including surface water control and perimeter channels, culverts in the sheet pile wall, and associated riprap aprons.

4.0 QUALITY ASSURANCE DOCUMENTATION

The following sections present minimum requirements of the CQA monitoring and testing documentation program to be performed by the QAO. This monitoring and testing program is intended to supplement requirements described in the Technical Specifications. In the event of any discrepancies the Remedial Designer shall be notified to clarify the appropriate requirements.

4.1 Earthwork

The earthwork CQA testing program consists of pre-construction and construction testing of native and imported soil such as grading fill, backfill, structural fill, geocomposite drainage layer, cover soil, vegetative support layer, and aggregate materials. The characteristics of these fill and soil types are defined in the Technical Specifications. Prior to and during construction, each soil type will be evaluated to determine whether it meets the requirements. Soil samples will be obtained in accordance with American Society for Testing and Materials (ASTM) standards ASTM D75 and ASTM D420, and will be tested by a geotechnical testing laboratory approved by the Remedial Designer.

4.1.1 Pre-Construction Testing

Pre-construction testing will be performed by the QAO on the imported materials to determine whether they meet requirements listed in the Technical Specifications. Soil samples will be provided from each proposed source. The specific tests to be performed by the QAO, and testing frequency will be done according to Table 4-1 below, or according Technical Specification if no testing is indicated in the Table.

**TABLE 4-1
PRE-CONSTRUCTION TESTING MINIMUM FREQUENCIES¹**

Test and Method	Grading Fill (cy)	Cover Soil (cy)	Vegetative Support Layer (cy)	Structural Fill (cy)
Particle Size ² (ASTM D422, C117, C136)	5,000	5,000	5,000	5,000
Atterberg Limits ³ (ASTM D4318)	5,000	5,000	---	5,000
Moisture Content ⁴ (ASTM D2216 or D4643)	5,000	5,000	5,000	5,000
Standard Proctor (ASTM D698)	10,000	---	---	10,000

Test and Method	Grading Fill (cy)	Cover Soil (cy)	Vegetative Support Layer (cy)	Structural Fill (cy)
pH (ASTM D4972)	---	---	5,000	--
Organic Content (ASTM D2974)	---	---	5,000	--
Specific Gravity (ASTM D854)	10,000	---	---	10,000
Soil Fertility (Baker or LaMotte Test)	---	---	5,000	--

¹Specific frequency refers to one test per the presented volume or one per material type or source, whichever is greater.

²ASTM D422 is applicable for fill, cover soil, and vegetative support layer. ASTM C117 and C136 are applicable to all other soil construction materials. Use the USCS for description and identification (ASTM D2488).

³For cohesive soils only.

⁴Natural moisture content.

4.1.2 Construction Testing

The tests to be performed by the QAO during construction for each material type, and frequency of those tests will be completed according to Table 4-2 below, or according Technical Specification if no testing is indicated in the Table.

**TABLE 4-2
CONSTRUCTION TESTING - MINIMUM FREQUENCIES¹**

Test and Method	Vegetative Support/Cover Soil Layers	Grading Fill	Structural Fill (cy)
In-Place Density (ASTM D2922)	----	10,000 sf/lift	10,000 sf /lift
Moisture Content (ASTM D3017)	----	10,000 sf/lift	10,000 sf /lift
Thickness ²	10,000 sf	10,000 sf	10,000 sf /lift

¹ Specific frequency refers to one test per the presented frequency or one per material type, whichever is greater.

²Thickness shall be checked by excavating test holes.

In accordance with Sections 02223 and 02599 of the Specifications, grading fill and structural fill materials shall be placed and compacted to achieve a minimum density of 90 percent of maximum dry density as determined by the Standard Proctor test (ASTM D698). Care shall be taken not to damage other portions of the Work during compaction of backfill, or proof-rolling. The moisture content of the grading fill and structural fill shall be such as defined in the Specifications. Puddling or jetting for compaction will not be permitted. Compaction testing of each lift of backfill and fill

will be completed. If the Contractor makes reasonable efforts, as determined by the QAO, to achieve the specified percent compaction but cannot meet the compaction requirement, an alternate percent recompaction, agreed upon by the Group's Representative and Remedial Designer, may be utilized.

Compaction of cover soil above the geocomposite drainage layer shall be achieved in accordance with the Technical Specifications.

4.1.3 Construction Monitoring

All earthwork will be monitored by the QAO to confirm and document that the construction is performed in general accordance with the Contract Documents. The Contractor will be responsible for establishing the design lines and grades. Visual observations or surveying by the Contractor, as appropriate, throughout the construction process, will be conducted and submitted to the QAO to evaluate whether the materials are placed to the lines and grades shown on the Contract Drawings.

4.2 Geosynthetics

The CQC requirements for the geosynthetics are listed in the Technical Specifications. The CQA program for geosynthetics consists of the Remedial Designer reviewing the Geosynthetics Installer's QC submittals, material conformance testing, construction monitoring, and testing. The types of geosynthetics used in the construction of the Remedy include geosynthetic clay liner (GCL), geomembrane, woven and non-woven geotextiles, and geocomposite drainage layer.

The geosynthetic QC submittals and material conformance testing requirements are defined in the Technical Specifications. Prior to and during construction, these geosynthetics will be sampled and tested to determine whether the materials meet the requirements listed in the Technical Specifications. Testing will be performed by a GeoSynthetics Institute (GSI) accredited Geosynthetics Laboratory, as approved by the Remedial Designer.

4.2.1 Conformance Testing

Prior to geosynthetics installation, samples of the geosynthetics will be obtained for conformance testing by the QAO. The conformance testing minimum frequency will be at a rate of 1 per 100,000 square feet from material delivered to the Site, or one sample per lot, whichever results in the greater number of conformance samples. Samples will be taken in accordance with applicable Technical Specifications. The QAO will mark the machine direction, roll number, lot number, date of manufacturer, manufacturer name, project specific information, and date the sample was obtained on the sample and forward the sample to the approved geosynthetics laboratory. The minimum required Geosynthetic conformance tests are described in the Technical Specifications and are summarized in Tables 4-3, 4-4, 4-5, and 4-6.

**TABLE 4-3
GCL CONFORMANCE TESTING**

Test	Test Method	Frequency (sf) ¹
Bentonite Content (at 0 percent moisture)	ASTM D5993	1/100,000
Hydraulic Conductivity (at 3 psi confirming pressure)	ASTM D5084	1/100,000
Grab Tensile Strength	ASTM D4632	1/100,000
Peel Strength	ASTM D6496	1/100,000

¹Specified frequency or one per lot, whichever is greater.

**TABLE 4-4
GEOMEMBRANE CONFORMANCE TESTING**

Test	Test Method	Frequency (sf) ¹
Density	ASTM D792/D1505	1/100,000
Carbon Black Content	ASTM D1603	1/100,000
Thickness	ASTM D5199/5994	1/100,000
Tensile Properties	ASTM D6693	1/100,000
Puncture Resistance	ASTM D4833	1/100,000
Carbon Black Dispersion	ASTM D5596	1/100,000
Tear Resistance	ASTM D1004 Die C	1/100,000

¹Specified frequency or one per lot, whichever is greater.

**TABLE 4-5
GEOTEXTILE CONFORMANCE TESTING AND FREQUENCIES**

Test	Test Method	Frequency (sf)¹
Mass per unit area	ASTM D5261	1/100,000
Grab Tensile Strength and Elongation	ASTM D4632	1/100,000
Puncture strength	ASTM D4833	1/100,000
Mullen Burst	ASTM D3786	1/100,000
Trapezoidal Tear	ASTM D4533	1/100,000
Apparent Opening Size ²	ASTM D4751	1/100,000

¹Specified frequency or one per lot, whichever is greater.

²For filter applications only

**TABLE 4-6
GEOCOMPOSITE CONFORMANCE TESTING AND FREQUENCIES**

Test	Test Method	Frequency (sf)¹
Geonet Thickness	ASTM D5199	1/100,000
Adhesion Strength	ASTM F904 modified	1/100,000
Geotextile AOS (upper component only)	ASTM 4751	1/100,000
Transmissivity	ASTM D4716	1/100,000

¹Specified frequency or one per lot, whichever is greater.

All conformance tests will be performed in accordance with the Technical Specifications. The QAO will review the test results and will report any nonconformance to the Group's Representative, the Remedial Designer, and the Contractor.

4.2.2 Construction Monitoring and Testing

All geosynthetic components will be monitored during installation. The QAO will review surveying information developed and submitted by the Contractor throughout the construction process to evaluate whether materials are placed to the lines and grades as shown on the Contract Drawings.

The QAO will review the following Contractor's Geosynthetics Installer documentation:

- CQC documentation recorded during installation;

- Daily reports detailing the personnel present on-site, the progress of the work, the arrival of materials, and any problems encountered; and,
- Subgrade surface acceptance certificates for each area to be covered by the geosynthetics, signed by the Geosynthetics Installer's Superintendent and the Contractor.

The QAO will observe and document the following items related to geosynthetics installation:

- Delivery and unloading of geosynthetic materials at the Site to verify that the materials are in good condition and properly labeled;
- Geosynthetic storage area shall be uniform and free of possible sources of damage, such as mud, dirt, debris, and dust, and meet all Technical Specification requirements;
- Geosynthetic packaging identification slips for verification and generation of an on-site materials inventory;
- Subgrade conditions prior to geosynthetics installation. Verify that any identified deficiencies (e.g., surface irregularities, loose soil, protrusions, in-place construction stakes, excessively soft areas, stones, desiccation cracks) are corrected;
- Lines and grades have been verified by the Contractor's surveyor;
- Handling of geosynthetic materials from storage to the work area;
- Temporary and permanent anchoring of geosynthetics; and,
- Required overlap distances are maintained.

4.2.3 GCL Monitoring

During shipment and storage, the GCL shall be wrapped in protective heavy-duty plastic or similar protective covering to prevent damage. Upon arrival to the Site, the QAO will inspect the material for damage. Rolls found to be damaged will be rejected. Materials will be stored in a dry location, free from disturbance and protected from moisture, soil, mud, dust, debris, traffic and vandalism.

Subgrade Condition

Prior to GCL placement, the QAO shall confirm that the subgrade surface is in an acceptable condition by walking the prepared subgrade with the GCL installer and reviewing the subgrade

acceptance certification prepared by the installer. Foreign materials and protrusions shall be removed. Cracks and voids shall be filled and the surface shall be smooth and uniformly sloping with no sharp grade breaks. The receiving soil surface shall be compacted in accordance with the Technical Specifications.

Prior to installation, the QAO shall confirm and document that the grades upon which the GCL is to be deployed are in agreement with those presented on the Contract Drawings, or are acceptable to the Remedial Designer, if they differ from the proposed grades. A Professional Surveyor licensed in the State of New Jersey, employed by the Contractor shall survey these grades and copies of the survey shall be provided to the QAO for review.

Installation

Installation of the GCL shall be performed to prevent damage to the underlying grading layer and the GCL itself and in accordance with the Technical Specifications. Heavy construction equipment shall not be operated directly on the GCL.

The following will be confirmed and documented by the QAO during the installation of the GCL:

- Placement of GCL is in accordance with the Specifications;
- Materials is not damaged during deployment;
- Only GCL being placed that day will be unwrapped;
- Geomembrane shall be placed immediately upon the GCL;
- GCL shall be kept dry and not be installed in standing water or during any precipitation or high winds;
- Overlapping of GCL is in accordance with the Technical Specifications;
- No soil or debris shall be entrapped in the overlapping zone;
- No hydrated edges of previously placed GCL are present at overlap of new work areas;
- Rolls deployed match the roll numbers of the manufacturer's quality control testing;

- GCL shall be inspected continuously for damage and shall be repaired or replaced, if defective, and,
- Placement of overlying materials shall be performed without damage to GCL.

4.2.4 Geomembrane Monitoring and Testing

During installation, the QAO will observe the Contractor's geomembrane deployment, trial seams, field seams, non-destructive and destructive seam testing, and repairs to document that the installation is in general accordance with the Technical Specifications.

Deployment

The QAO will verify that only favorably reviewed materials are used, that each panel is given a unique panel number, geomembrane is not placed during inclement or other unsuitable weather conditions, the geomembrane is not damaged during installation, and anchoring is performed in accordance with the Technical Specifications and Contract Drawings. The QAO will record pertinent information pertaining to deployment including seam number, roll number, date, visual panel condition, seam overlaps, and length of wide of panel.

Trial Seams

The QAO will verify that seaming conditions are adequate, tests are performed at required intervals, specified test procedures are followed, and that retests are performed in accordance with the Technical Specifications. The Geosynthetics Installer will perform pre-weld testing (trial seaming) at the beginning of each crew shift, every five hours thereafter, after an equipment shutdown, and immediately following any work stoppage of one hour or more, or changes in seaming process. Seaming operations will not commence until the QAO has determined that the seaming process is meeting the Technical Specification requirements and is acceptable. Visual observation of the trial seam by the QAO is required. The QAO will mark the test weld with date, ambient temperature, welding machine number, welding technician initials, machine temperature, and speed. For extrusion welding, the QAO will record the nozzle and extrusion settings. The trial seam sample will be archived by the QAO at the Site. The QAO will record the trial seam test results as passing or failing, as well as peel strength values and failure mode based on ASTM D6392.

Field Seaming

The QAO will verify that only favorably reviewed equipment and personnel perform welding, all welding is performed under suitable conditions as per the specifications, specified overlaps are achieved, seams are oriented in accordance with project requirements, and that grinding techniques and extrudate meet project requirements for extrusion welding. The QAO will record pertinent information pertaining to field seaming, including date, time, seam length, welder identification, welding device, ambient temperature, nozzle or wedge setting and actual temperature, and wedge speed.

Non-Destructive Seam Continuity Testing

The QAO will verify that all seam lengths are non-destructively tested by the Contractor in accordance with the Technical Specifications. If the seam cannot be tested, the QAO will observe cap strip operations and verify that test equipment and gauges are functioning properly and that test procedures are in accordance with the project requirements. The QAO will verify that all failing seam lengths are repaired and re-tested until passing results are achieved. The QAO will record all pertinent data relating to non-destructive testing. For air pressure testing, this includes date, start and end times, initial and final pressure, seam segment, and indication of pass or fail. For vacuum testing, this includes date, seam segment, QC technician, and indication of pass or fail.

Destructive Seam Testing

The Contractor's Geosynthetic Installer will furnish destructive testing samples of the field seamed geomembrane in accordance with the Technical Specifications, at locations selected by the QAO. The samples will be taken and prioritized as follows:

- Areas identified as suspect during seaming or non-destructive testing/monitoring;
- A minimum of one sample for each geomembrane seamer;
- A minimum of one sample for each representative working conditions (e.g., weather conditions); and,
- A minimum of one sample for every 500 linear feet of seaming.

Two specimens shall be cut from the field seam at the location indicated by the QAO and in accordance with the Technical Specifications, with the seam centered parallel to the specimen width. The distance between these two specimens shall be forty-two (42) inches measured along the seam. Both specimens will be cut and tested for peel adhesion in accordance with the Technical Specifications. The installer shall provide the test results to the QAO upon completion of the tests.

If the specimen fails, the Geosynthetic Installer will follow the requirements of the Technical Specifications for tracking and repair of failed destructive test samples. A minimum of four of the five samples must meet the minimum peel and shear criteria listed in the Technical Specifications. Both tracks of double-track fusion seams will be destructively tested for peel.

Failed seams will be tracked according to the welding apparatus and the machine operator. Samples taken as a result of failed tests will not be counted toward the total number of destructive tests required. All failed field seams must be documented to be bounded on both sides by passing destructive tests. The results of laboratory destructive tests conducted by the QAO will govern the acceptability of seams.

The Geosynthetics Installer shall be responsible for patching all areas cut for test samples and for non-destructive testing (e.g. vacuum box, etc.) in accordance with the Technical Specifications. The QAO will observe this work and record test locations, results, actions taken in conjunction with destructive test failures, and repairs.

Repairs

The QAO shall observe and document that all materials, techniques, and procedures used for repairs are favorably reviewed in advance. The QAO will verify that all repairs are marked, recorded, tested, and that wrinkles are addressed, prior to being covered by other materials. The QAO will record pertinent data relating to the locations of defects and repairs as specified in the Technical Specifications, including date and time repaired, seam segment/location, defect type, repair type and dimensions, welder identification, welding device, and date and result of nondestructive testing.

4.2.5 Geotextile and Geocomposite Monitoring

During geotextile and geocomposite installation, the QAO will observe the Contractor's deployment, field seaming, and repairs, and document whether the Contractor's installation is in accordance with the Technical Specifications.

Deployment

The QAO will verify that the underlying layers are clean and free of deleterious materials prior to deployment, anchoring is achieved as specified, methods are used to minimize wrinkles, and underlying layers are protected during cutting of materials.

Seams

The QAO will verify sufficient seam overlap and that the specified seam procedures are followed as required in the Technical Specifications.

Repairs

The QAO will verify that all repairs are performed in accordance with project Technical Specifications.

Protection

The QAO will verify that geotextiles and geocomposites shall be covered within the maximum exposure time recommended by the manufacturer, but in no case longer than 30 days following placement.

4.3 Enhanced Groundwater Extraction System

The following describes the CQA procedures to be implemented during the Contractor's installation of the extraction wells, piezometers, pre-fabricated building, and storage tank as shown on the Contract Drawings. Locations may be adjusted, if difficulty in drilling is encountered and if authorized by the QAO.

The QAO will observe the following activities during the Contractor's installation of the new extraction system:

- Start and completion date;
- Health and safety monitoring, including air monitoring;
- Inspection of materials, and receipt of material certifications as required by Technical Specifications;
- Extraction well and piezometer location;
- Type of drilling rig and equipment;
- Contractor measurement of airborne chemical concentrations in the working area;
- Logging of material types encountered during drilling;
- Measurement of the total drilling depth;
- Measurement of depth to encountered liquids, as applicable;
- Measurement of depth to bottom of the wells and piezometers;
- Monitoring of depth to pipe connections;
- Measurement of the depths to and lengths of perforated and solid sections of piping and well screens;
- Measurement of thickness of all components of the wells and piezometers (gravel, filter sand, bentonite plug);
- Measurement of the installed dimensions of installations above and below grade;
- Monitoring of the well-head assembly;
- Documenting that associated valves, casing pipes, and hardware are installed and operative;
- Final surveying of wells and piezometers;
- Observation and review of Contractor's quality control testing of concrete and compaction testing of soil and fill in accordance with Technical Specifications.
- Measurement of thickness, and placement and compaction of pipe bedding and backfill materials around the collection and conveyance pipes;
- Monitoring of joints and connections, alignment of pipe, and pipe boot connections;

- Observation of required pressure testing of the pipe;
- Installation of the control panels;
- Construction of the prefabricated building and tank according to the Technical specifications;
- Installation of control system for the groundwater extraction system; and
- System startup.

Mechanical/Electrical

The Contract Documents will require that the CONTRACTOR observe, in conformance with the Technical Specifications, Contract Drawings, and Manufacturer guidelines, the mechanical and electrical equipment installation for the groundwater extraction system. The CONTRACTOR will submit manufacturer operations manuals, guidelines, and other pertinent information for inclusion in the project Operations and Maintenance Manual.

The following activities by the QAO are anticipated:

- Observe the installation of pneumatic operation system for pumps, including compressor and building, and electrical supply for controls and inspect it for physical defects;
- Observe mechanical checkout by the CONTRACTOR; and,
- Review field calibration sheets for all field instrumentation such as level sensors.

At a minimum, the CONTRACTOR will perform and submit documentation for the following:

- Submit calibration sheets for all instrumentation;
- Complete a mechanical checkout of all electrical equipment;
- Submit as-built information regarding location, connections, and controls; and,
- Submit warranties on all applicable products.

Demolition / Decommissioning

The QAO will observe the following activities during the Contractor's demolition/decommissioning of the current extraction system, building and tank on site to verify they are completed in compliance with the Technical Specifications:

- Abatement of regulated materials within the building;
- Demolition of the building;
- Draining of current extraction system;
- Decommissioning of current extraction system piping and control system;
- Waste storage and disposal;
- Disconnection and capping of designated utilities; and
- Backfilling and regrading of disturbed areas.

Any significant deviation by the Contractor from the Technical Specifications, Contract Drawings, or Manufacturer guidelines will be brought to the immediate attention of the Group's Representative and Remedial Designer, by the QAO.

4.4 Stormwater Management

The QAO will visually inspect the stormwater management features as they are installed, noting observation relative to the following:

- Tie-ins with the cap components;
- Culvert installation, including excavation, pipe placement and slope, bedding and backfill placement, and compaction;
- Measurement of channel dimensions;
- Survey layout and final survey, including checking that slopes are within ranges listed on the Contract Drawings;
- Anchoring of turf reinforcement mat;
- Use of approved materials; and,
- Adequate thickness lining of materials (e.g., riprap, reno mattress, etc.).

The QAO will perform required testing of fill and backfill associated with stormwater management features in accordance with Tables 4-1 and 4-2 and the Technical Specifications.

4.5 In Situ “Hot Spot” Treatment

The QA program for the “hot spot” treatment will consist of monitoring of the air stripping and in situ stabilization operations. The QAO will verify material certifications are obtained and reviewed as required by the Technical Specifications. The QAO will observe the following activities during the in situ treatment to ensure they are completed in accordance with the Technical Specifications:

- Delivery and storage of materials;
- Clearing and preparation of the work area;
- Survey of the “hot spot” area to determine treatment area;
- Completion of the field verification program establishing rates for in situ air stripping (ISAS) and in situ stabilization (ISS) advancement / penetration, ISAS mixing times, and quality control testing requirements;
- Establishment of column depths / elevations;
- Implementation of ISAS and ISS including, proper stability, handling of excess materials, construction in accordance with Contract Drawings, and completion of specified quality control measures;
- Recording of required field data; and
- Sample collection.

Sampling Requirements

The minimum tests to be performed by the Contractor during “hot spot” treatment, and frequency of those tests will be completed according to Tables 4-7 and 4-8 below, according to the Technical Specifications, or as directed by the Remedial Designer.

TABLE 4-7
ISAS/ISS COLUMN CONTINUITY AND DEPTH CONTROL

Item/Test	Reference Test Standard	Frequency (min.)	Criteria
Column Verticality	None	1 per column	Within two (2) percent of vertical.
Column Depths/Elevations	None	1 per column	Within two (2) inches of depths shown in the Contract Drawings.
Column Alignment (horizontal)	Survey	1 per column	Within six (6) inches of the Contractor's approved ISAS/ISS Shop Drawing locations.

TABLE 4-8
ISS SLURRY MATERIAL CONTROL

Item/Test	Reference Test Standard	Frequency	Criteria
Injection Ratio	None	1 per stroke	Ratio varies based on tailings conditions and workability.
Penetration Ratio	Visual	1 per stroke	As required.
Slurry Material Proportion	None	1 per stroke	Percentage of slurry material.
Slurry Material Uniformity	Visual	1 per stroke	Visual appearance of mixture homogeneity.

The QAO will verify that the Contractor uses approved sampling devices to sample mixed ISAS/ISS columns, and that sampling occurs prior to solidification of ISS slurry materials. Sample locations will be randomly distributed as directed by the Remedial Designer. After the quality control samples, have sufficiently cured, they shall be tested, in accordance with the Technical Specifications on-Site or at off-Site laboratories. If quality control samples are transported to designated, approved off-Site testing laboratories, those samples shall be transported under appropriate "chains-of-custody".

Failed QC Tests

As per the Technical Specifications, if any QC testing fails to comply with the specified performance criteria, the Contractor shall delineate the impacted ISAS/ISS treatment areas which do not comply. The Contractor shall then remedy these areas by re-mixing the associated columns or implementing alternate corrective actions, as approved by the Remedial Designer.

Following corrective actions the Contractor shall perform additional QC testing to verify that the specified performance criteria have been achieved.

4.6 Streambank Enhancement – Peach Island Creek

The QA program for the streambank enhancements will consist of monitoring the installation of the new sheet pile wall, removal of fill between the old and new sheet pile wall, and cutting and removal of the old sheet pile wall at the Peach Island Creek water line. The QAO will verify receipt of all required material certifications as per the Technical Requirements. The QAO will observe the following activities:

- Installation of new sheet pile wall including:
 - Delivery, storage, and handling of materials;
 - Verification that the location, arrangement, and length of the steel sheets are in accordance with Contract Drawings;
 - Surveying of sheet piling locations;
 - Driving of sheet piles;
 - Verification that sheet piling is driven plumb and does not deviate from vertical by more than 1/8 inch per foot;
 - Implementation of corrective measures as needed; and
 - Proper installation of splices and sealing where necessary.

5.0 RECORDS AND REPORTING

5.1 Contract Drawings

The Contractors' Superintendent and the Group's Representative will each maintain on the Site one clean set of the Contract Drawings, Final Design Report, Technical Specifications, and other reports pertinent to the construction of the remedy, along with a record of all proposed, pending, and approved changes and clarifications to the Contract Documents. Additionally, the Contractor will maintain on-site, at all times, one set of marked-up Record Drawings indicating progress of construction.

5.2 Contract Submittals

Submittals required by this CQAP and the Technical Specifications will be logged in at the time of receipt by the Group's Representative. A record of the submittal and review form indicating favorable review or rejection of the submittal will be kept on file in the field by the QAO and at the office of the Remedial Designer. A copy indicating the final status will be returned to the Contractor for his files.

5.3 Daily Records

The QAO will keep records of construction and testing activities which, in conjunction with the Contractor's submittals and as-built drawings, will enable preparation of Record Drawings and the Final Record Documentation Report.

The QAO will prepare Daily Summary Reports, which will be numbered sequentially and will include the following:

- Date and project name;
- Weather conditions, including daily high and low temperature, wind conditions, and precipitation;
- General description of work activities at the Site;
- Description of work completed for the day, referencing stationing and grid coordinates, as appropriate;

- Identification of areas worked including lift number, panel number, and/or seam number;
- Reduced-scale drawings or sketches showing work completed;
- Summary of test samples taken, with locations and elevations, as appropriate;
- Summary of CQC test results, provided to the QAO by the Contractor, compared with Specification requirements and indication of pass or fail status for the samples;
- Test equipment calibrations, unless recorded in other field notebooks;
- List of off-site materials received;
- Summary of CQA and CQC procedures used for the day and list of CQA personnel on-site;
- Results of all CQA tests performed;
- Results of all laboratory test data received;
- Estimate of all materials placed or installed; and,
- Problems encountered and resolutions reached.

5.4 Construction Problem and Corrective Measure Reports

A construction problem is defined herein as material or workmanship that apparently does not meet the requirements of the Contract Documents. Construction Problem Reports will be prepared by the QAO and will be numbered sequentially. Each report will be cross-referenced to specific monitoring and testing data sheets where the problem was identified. Corrective Measures Reports shall be prepared by the QAO following correction of the problem and will be correlated to the associated Construction Problem Report. These reports will include the following information:

- Detailed description of the problem;
- Location and probable cause of the problem;
- How and when the situation was identified;
- How the problem was corrected or resolved;
- Any measures taken to prevent similar problems in the future; and,
- Signatures of QAO, the Group's Representative, and Contractor's Superintendent.

5.5 Photographic Records

The QAO will take photographs identified by date, time, location, and name of person taking the photograph. Photographic record sheets will be completed to organize the photographs. Such sheets will be numbered sequentially and will include the following information:

- The date, time, and location where the photograph was taken and weather conditions;
- The size, scale, and orientation of the subject matter photographed;
- Location and description of the work;
- The purpose of the photograph; and,
- Initials of the photographer.

5.6 Final Record Documentation Report

Within 90 days of completion of construction, the QAO, Remedial Designer, and the Group's Representative will complete the Final Record Documentation Report (Report) for the project. The Report, submitted to the USEPA, will certify that, based on the QAO's observations of the Contractor's work and on evaluation of furnished test results and other information, the Contractor's work has been completed in substantial conformance with the Contract Drawings, Technical Specifications, with any significant exceptions noted. The report will include the following:

- Narrative description of construction activities completed at the Site;
- Description of material deviations from the Contract Documents requirements and justification for such changes;
- Description of CQA testing procedures;
- Summary of CQA test data including summary tables of all soil and geosynthetics monitoring and test results;
- Maps and drawings showing CQA test and sample locations, if appropriate;
- Descriptions of procedures used by the Contractor to rework or repair areas with failing CQA test results;

- Color photographs of major project features;
- As-built plans and details of the completed construction, prepared by the Contractor;
- Certification statement for portions of the work monitored by the QAO that the construction was completed in substantial accordance with the Contract Documents.

5.7 Records Storage

Throughout the construction, original documents or copies will be kept in an organized file on-site. All records and documents relating to the Remedial Action will be preserved and retained for a minimum of 10 years following receipt from USEPA of a Certificate of Completion of the Work. At the close of this 10-year period, documents may be destroyed with USEPA concurrence in accordance with the procedures outlined in the Consent Decree.

6.0 PLAN MODIFICATION PROCEDURE

Should this CQAP require modification, the proposed change will be submitted in writing to the Remedial Designer and the Group's Representative for review. If the proposed modification is deemed to be appropriate, a letter requesting approval of the change will be submitted to the USEPA. An addendum will be attached to all copies of the CQAP following receipt of approval from the USEPA.

APPENDIX I

**OPERATIONS AND MAINTENANCE (O&M) PLAN
(ANNOTATED TABLE OF CONTENTS ONLY)**

**216 PATERSON PLANK ROAD SITE – OPERABLE UNIT NO. 2 (OU-2)
CARLSTADT, BERGEN COUNTY, NEW JERSEY**

**OPERATIONS AND MAINTENANCE (O&M) PLAN
ANNOTATED TABLE OF CONTENTS**

SECTION

1.0	INTRODUCTION
	<i>(This section will provide descriptions of the Site, state the purpose for this O&M Plan, and briefly summarize its contents.)</i>
2.0	SITE BACKGROUND
	<i>(This section will provide descriptions of the general Site overview, history, Consent Decree requirements, and a summary of the OU-2 Remedial Action.)</i>
2.1	Consent Decree Requirements.....
	<i>(This section will provide a summary of the regulatory history for the site, as well as the USEPA requirements for the contents of an O&M Plan.)</i>
2.2	OU-2 Remedy.....
	<i>(This section will provide an overview and summary of construction activities completed as part of the OU-2 Remedy.)</i>
3.0	PROJECT ORGANIZATIONAL STRUCTURE.....
	<i>(This section will provide summaries and descriptions of their roles and responsibilities for each party involved in subsequent O&M activities.)</i>
4.0	OVERVIEW OF REMEDIAL SYSTEMS OPERATIONS.....
	<i>(This section will provide descriptions for each primary component of the constructed OU-2 Remedy.)</i>
4.1	Cover System.....
	<i>(This section will describe the various components of the engineered cap and their properties, as well as a description of Site grading, cap transitions, and stormwater management features.)</i>
4.2	Stream Bank Enhancements.....
	<i>(This section will provide descriptions of the installed enhancements along Peach Island creek.)</i>
4.3	In-Situ “Hot Spot” Treatment.....
	<i>(This section will describe the remediation of the sludge Hot Spot treatment by In-Situ Air Stripping and In-Situ Soil Stabilization operations.)</i>
4.4	Enhanced Groundwater Recovery System.....
	<i>(This section will provide descriptions of the installed new groundwater recovery system, which will include details regarding the newly installed extraction wells, carrier pipes, on-Site leachate holding tank, and constructed pre-engineered building structures.)</i>

**216 PATERSON PLANK ROAD SITE – OPERABLE UNIT NO. 2 (OU-2)
CARLSTADT, BERGEN COUNTY, NEW JERSEY**

**OPERATIONS AND MAINTENANCE (O&M) PLAN
ANNOTATED TABLE OF CONTENTS (CONT'D)**

5.0	OPERATION AND MAINTENANCE ACTIVITIES
	<i>(This section will describe the O&M activities in connection with the constructed OU-2 Remedy.)</i>
5.1	Cover System.....
	<i>(This section will describe the nature and extents of all require O&M activities in connection with the constructed cover system, including periodic inspection and anticipated system maintenance and repair procedures.)</i>
5.2	Steam Bank Enhancements.....
	<i>(This section will describe the nature and extents of all require O&M activities in connection with the installed new sheet pile wall, including periodic inspection and anticipated maintenance and repair procedures.)</i>
5.3	In-Situ “Hot Spot” Treatment.....
	<i>(This section will describe the nature and extents of all require O&M activities, if any, in connection with the completed in-situ treatment activities.)</i>
5.4	Enhanced Groundwater Recovery System.....
	<i>(This section will describe the nature and extents of all require O&M activities in connection with the installed new groundwater recovery system, including periodic inspection, testing, water level measurement, and anticipated system maintenance and repair procedures.)</i>
5.0	HEALTH AND SAFETY
	<i>The section will provide requirements for the preparation of a Site-specific Health and Safety Plan (HASP) for the on-going O&M operations. Ultimately, the selected O&M Operator will prepare this HASP, and this plan will be submitted to the Group’s Representative for review and approval, prior to commencing any O&M activities on-Site.</i>
6.0	REPORTING AND RECORDKEEPING
	<i>This section will describe the reporting procedures for inspection, maintenance, and monitoring activities during the O&M period. Frequencies of inspections and reporting requirements will also be described in this section.</i>
7.0	MODIFICATION PROCEDURES
	<i>Over the course of the O&M period, it may be appropriate to modify the approved O&M Plan, based upon Site experiences. Hence, this section will establish procedures and protocols for modifying the approved O&M Plan.</i>
8.0	REFERENCES

**216 PATERSON PLANK ROAD SITE – OPERABLE UNIT NO. 2 (OU-2)
CARLSTADT, BERGEN COUNTY, NEW JERSEY**

**OPERATIONS AND MAINTENANCE (O&M) PLAN
ANNOTATED TABLE OF CONTENTS (CONT'D)**

TABLES

Tables will be provided on an as needed/necessary basis.

FIGURES

At a minimum, record “as-built” drawings will be reproduced, and incorporated into this O&M, as figures and as necessary.

APPENDICES

At a minimum, this O&M plan will incorporate appendices, including the following: a) representative “as-built” product information (i.e., material specifications, manuals, materials safety data sheets, etc...); b) copies of Contractor submittals, requests for information, change orders, and Site inspection reports; and c) copies of all applicable manufacturer operation and manuals for all installed remedial systems.

APPENDIX J

STREAM ENCROACHMENT PERMIT EQUIVALENCY

**NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
MINOR STREAM ENCROACHMENT PERMIT EQUIVALENCY**

For

**Operable Unit No. 2 (OU-2) Remedial Activities
Paterson Plank Road Superfund Site
Block 124; Lots 1, 2, 3, 4 & 5
Carlstadt Borough
Bergen County, New Jersey**

May 2, 2007

PREPARED FOR:

216 Paterson Plank Road Cooperating PRP Group
c/o 200 Century Parkway, Suite C
Mt. Laurel, New Jersey 08054

PREPARED BY:

AMY S. GREENE ENVIRONMENTAL
CONSULTANTS, INC.
4 Walter E. Foran Boulevard, Suite 209
Flemington, New Jersey 08822
ASGECI #2425

May 2, 2007

OVERVIEW

Minor Stream Encroachment Permit Equivalency
Paterson Plank Road Superfund Site
Block 124; Lots 1, 2, 3, 4 & 5
Carlstadt Borough, Bergen County, New Jersey
DLUR File # 0205-06-0002.1
CERCLA Project # NJD070565403

APPLICANT: 216 Paterson Plank Road Cooperating PRP Group
c/o Golder Associates, Inc.
200 Century Parkway, Suite C
Mt. Laurel, New Jersey 08054
(856) 793-2006
Attn: P. Stephen Finn, C. Eng.
ASGECI Project #2425

OWNER: Borough of Carlstadt
500 Madison Street
Carlstadt, New Jersey 07072

On behalf of the Paterson Plank Road PRP Group, Amy S. Greene Environmental Consultants, Inc. (ASGECI) has prepared this Minor Stream Encroachment Permit Equivalency for stream bank stabilization as part of the site remediation activities at the 216 Paterson Plank Road Superfund Site located in Carlstadt Borough, Bergen County, New Jersey. The project site is situated within the regulatory boundaries of the New Jersey Meadowlands Commission.

According to EPA policy, CERCLA response actions conducted on-Site are exempted by law from the requirement to obtain Federal, State or local permits; however, said response actions are still required to meet the substantive provisions of permitting regulations that are considered Applicable or Relevant and Appropriate Requirements (ARARs). Therefore, under CERCLA, the remedial activities proposed in USEPA's Record of Decision (ROD) have been designed through the permit "equivalency" process to address the ARARs. The permit equivalency process is similar to the standard permitting process except that administrative requirements are waived, such as permit fees, public notice requirements, and landowner signatures.

Several communications have occurred between ASGECI staff and the New Jersey Department of Environmental Protection (NJDEP), including conversations with Dennis Contois of NJDEP Division of Land Use Regulation (DLUR) on March 28 & 30, and April 17, 2007 and Diane Dow of NJDEP DLUR on March 29, 2007. ASGECI indicated to Ms. Dow that no activities (removal of the existing bulkhead and placement of a new bulkhead landward of the existing

wall) are proposed at or below the Mean High Water Line (MHWL) of tidal waters, which is conservatively presumed to be located at the existing bulkhead along Peach Island Creek. Ms. Dow of NJDEP confirmed that no Waterfront Development Permit equivalency would be required for the project since the proposed activities would be landward of the MHWL. Dennis Contois confirmed that if the project does not require a Waterfront Development Permit, a Minor Stream Encroachment Permit (SEP) equivalency would be required for the project, for activities adjacent to Peach Island Creek, in accordance with the NJ Flood Hazard Area Control Act. The SEP equivalency must demonstrate project consistency with the Environmental Standards of the Flood Hazard Area Control Act rules. As Peach Island Creek is a tidally influenced body of water, only the environmental standards are required to be addressed in the permit equivalency.

Authorization from the US Army Corps of Engineers, New York City District, is not required for the project. No activities are proposed in waters of the US. Furthermore, activities undertaken entirely on a CERCLA site by authority of CERCLA, as required by USEPA, are not required to obtain permits under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act.

Enclosed are all items required for a Minor Stream Encroachment Permit Equivalency, which is being submitted as part of the 100% Design Report for Operable Unit (OU-2). Specific Plans relative to the permit equivalency are part of the 100% Design Drawings and are therefore referenced accordingly herein. A stability analysis for the bulkhead is included in Appendix F of the 100% Design Report and is entitled: Stream bank Enhancement Suitability Analysis, dated 10/26/2006. As a Permit Equivalency, this document does not include payment of fees, does not provide notice to adjacent property owners and does not include any signatures of landowners. Adjacent property owners are already aware of the work through USEPA's Community Relations Program.

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1. NJDEP STREAM ENCROACHMENT ADMINISTRATIVE CHECKLIST
NJDEP DIVISION OF LAND USE REGULATION APPLICATION FORM (LURP #2)
WITH ATTACHMENT FOR ITEM #6 OF LURP #2 FORM – PROJECT
DESCRIPTION
2. ENVIRONMENTAL REPORT:
SITE INFORMATION

STATEMENT OF COMPLIANCE WITH NJ FLOOD HAZARD AREA
CONTROL ACT (N.J.A.C. 7:13) ENVIRONMENTAL STANDARDS
3. SITE FIGURES

Figure 1 – Municipal Tax Map
Figure 2 – County Road Map
Figure 3 – USGS Topographic Map
Figure 4 – SSURGO Soils / Aerial Map
4. SITE PHOTOGRAPHS WITH DESCRIPTIONS
5. CORRESPONDENCE
Natural Heritage Letter
6. RESUME OF PREPARERS
7. STABILITY ANALYSIS FOR PROPOSED BULKHEAD - Appendix F of the 100%
Design Report entitled: Stream bank Enhancement Suitability Analysis, dated
10/26/2006.
8. PERMIT PLANS - Provided as design drawings in the 100% Design Report.

SECTION #1

Minor Stream Encroachment Permit Equivalency

Block 124; Lots 1, 2, 3, 4 & 5

Carlstadt Borough, Bergen County, New Jersey

ASGECI #2425

NJDEP STREAM ENCROACHMENT ADMINISTRATIVE CHECKLIST



State of New Jersey Department of Environmental Protection



STREAM ENCROACHMENT ADMINISTRATIVE CHECKLIST

Revised: January 3, 2006 Website: www.state.nj.us/dep/landuse

A stream encroachment permit is required for most construction activities along streams and in floodplains. Examples of regulated activities include new buildings, roads, bridges, utility lines and stormwater discharges. Storing material, placing fill and clearing vegetation can also be regulated. Some minor activities are exempt.

To apply for a permit complete this checklist and send the material required below to the following address:

Postal Mailing Address:
NJDEP Land Use Regulation Program
P.O. Box 439
Trenton, NJ 08625

Street Address (For courier service and hand deliveries only):
NJDEP Land Use Regulation Program
501 East State Street, Station Plaza Five, 2nd Floor
Trenton, NJ 08609

CONTACT A STREAM ENCROACHMENT ENGINEER AT (609) 292-0060 IF YOU HAVE ANY QUESTIONS

PART A: The following is required for all projects (please do not send more copies of items than is required):

- ☒ One completed copy of this checklist.
- ☒ One completed LURP-1 application form with original signatures (available from DEP website above).
- ☒ Check or money order for the project review fee payable to: *Treasurer, State of New Jersey* (see Part F).
- ☒ Two sets of location maps (USGS quad map is required; local tax, county soil and flood maps where available).
- ☒ Two sets of color photographs showing the entire project area (mounted on 8½" by 11" paper).
- ☒ Three copies of an environmental report (see Part E).
- ☒ Six sets of individually folded, signed and sealed construction plans referencing 1929 NGVD. Show all proposed work and provide soil erosion/sediment control plans, cross-sections, profiles and details as appropriate.

PART B: The following is required for certain projects depending on your answers in Part C below:

- ☒ One copy of proof of local notice to all parties listed at N.J.A.C. 7:13-4.2 (see Part C question 6).
- ☒ One copy of a signed and sealed engineering report (see Part D).
- ☒ One copy of a hardship waiver request, if the project does not meet all regulations (see N.J.A.C. 7:13-4.8).

PART C: Please answer the following questions:

1. In most cases the extent of the floodplain must be known in order to issue a permit. Check one of the following:
 - ☐ Floodplain was taken from a State flood hazard area delineation (get State maps at (609) 292-2296).
 - ☒ Floodplain was taken from a tidal FEMA map that shows flood elevations (get FEMA maps at (800) 358-9616).
 - ☐ Floodplain was taken from a non-tidal FEMA map that shows flood elevations in a fully developed watershed.
 - ☐ Floodplain is unknown and calculations have been submitted to delineate it (see question 5).
 - ☐ Floodplain is unknown and does not need to be delineated for the project (explain why).
2. All streams have a buffer (measured from the top of the bank) within which vegetation is protected as follows:
 - ☐ 300 ft Along Category-One waters if stormwater management does apply under question 4 below.
 - ☐ 50 ft Along Category-One waters if stormwater management does not apply under question 4 below.
 - ☐ 50 ft Along trout-associated waters.
 - ☐ 50 ft Along waters associated with threatened or endangered species.
 - ☐ 50 ft Along waters where acid-producing soils will be exposed.
 - ☒ 25 ft Along all waters not listed above.
3. The placement of fill is restricted in a flood fringe and no obstruction is allowed in a floodway (check all that apply):
 - ☐ No fill is proposed within either the flood fringe or the floodway.
 - ☐ A negligible amount of fill is proposed within the floodway, which obviously does not obstruct flow.
 - ☒ A negligible amount of fill is proposed within the flood fringe, which obviously meets the rules by inspection.
 - ☐ Fill is proposed in the flood fringe and proof that the standards at N.J.A.C. 7:13-2.14 and 15 are met is included.
4. Stormwater management must be provided as described below (see www.njstormwater.org for more information). Check (and explain) if project is: ☐ Exempted at N.J.A.C. 7:8-5.2(d) ☐ Waived at N.J.A.C. 7:8-5.2(e)

Part 1: Enter the total amount of land that will be disturbed onsite: 5.9 ft² or acres (circle one).
If at least 1 acre (43,560 ft²) of land will be disturbed, submit the following (within the engineering report):

- ☐ One completed Low Impact Design checklist (see Appendix A of BMP manual at www.njstormwater.org).
- ☐ One copy of a USGS map, showing the site and its HUC-14 watershed, and indicating any 300-ft buffers onsite.
- ☐ Proof that the groundwater recharge standards at N.J.A.C. 7:8-5.4(a)2 are met (unless exempted at 5.4(a)2ii).
- ☐ Proof that the runoff quantity standards at N.J.A.C. 7:8-5.4(a)3 are met (unless project lies in a tidal floodplain and it is obvious that runoff from the site will not increase downstream flooding).

Part 2: Enter the net-increase in impervious area onsite: 0 ft² or acres (circle one). Include all new impervious areas, as well as existing impervious areas from which stormwater currently sheet-flows, but which will be collected into a basin or storm sewer system. Subtract any impervious areas being removed onsite. If a net-increase of at least ¼ acre (10,890 ft²) of impervious area will occur, submit all material in Part 1 and the following:

- ☐ Proof (within the engineering report) that the water quality standards at N.J.A.C. 7:8-5.5 are met.

5. Hydrologic and hydraulic calculations are generally required if any of the following occur (check all that apply):

- ☐ The peak 100-year flow in the stream will be significantly increased or decreased.
- ☐ The size, shape, skew, location and/or alignment of the stream channel will be altered.
- ☐ A new bridge or culvert will be constructed where none currently exists.
- ☒ A replacement bridge or culvert will be constructed, which is different in size, length, shape, material, skew, location and/or alignment from the existing structure.
- ☐ The floodplain limits are unknown and need to be delineated in order to demonstrate compliance with the requirements of the rules, such as for net-fill calculations or determining lowest floor elevations.
- ☐ The floodplain limits are unknown and need to be delineated to establish stream encroachment lines.

6. Proof of local notice (under N.J.A.C. 7:13-4.2) is required if any of the following occur (check all that apply):

- ☐ The project includes one or more major element under Part F.
- ☒ The project will disturb the channel or buffer of a trout-associated water (see question 2 above for buffer widths).
- ☒ The project will expose acid-producing soils.
- ☐ The project involves a hardship waiver request (under N.J.A.C. 7:13-4.8).

PART D: Engineering report: Must be signed and sealed by a NJ licensed professional engineer. Detail all regulated activities onsite and clearly explain how the submitted calculations demonstrate compliance with the rules. If the project fails to meet any regulation, detail the remedial or alternate techniques and measures that are proposed in compensation. Provide complete printouts (and electronic copies if possible) of all calculations. Check all that apply:

- ☒ Net-fill calculations (see Part C question 3). Explain the methodology used to demonstrate compliance. Include both existing and proposed flood storage calculations and depict all cross-sections and other relevant data.
- ☒ Stormwater management (see Part C question 4). Explain how the groundwater recharge, runoff quantity and water quality standards at N.J.A.C. 7:8 are met. Detail how TSS removal is achieved, provide detention, retention and infiltration calculations for all basins, and compare existing and proposed recharge and discharge rates.
- ☒ Hydrologic and hydraulic calculations (see Part C question 5). Include any State or FEMA flood maps or profiles that were referenced (with site outlined to scale on maps). If flow rates were determined for a stream, depict the contributory drainage area on USGS maps and provide a hydrologic description of the watershed.
- ☒ Stability analysis for any retaining wall that is at least 4 ft high. Include both sliding and overturning analyses.

PART E: Environmental report: Address all proposed environmental impacts including, at minimum, the following:

- ☒ A complete description of the project, including justification for its size and location, an evaluation of all anticipated environmental impacts and a demonstration that such impacts have been minimized where possible.
- ☒ State plane coordinates of the site.
- ☒ A description of all anticipated access points along streams and proposed disturbance to vegetation within the appropriate stream buffer (see Part C question 2), as well as all in-channel soil erosion measures.
- ☒ Adverse effects of any stormwater management basins on the stream's biota and on mosquito breeding.
- ☒ An evaluation and mitigation plan if acid-producing soils will be exposed.
- ☒ An evaluation of whether threatened and endangered species will be impacted.
- ☒ The qualifications of the report's preparer and all relevant data that was used in the report's preparation.

PART F: The total review fee is \$ N/A and was calculated as follows (indicate number of each element):

Stormwater review fee (if any) \$ _____
(Attach stormwater fee worksheet)

Major element (\$4,000)

- ___ Hardship waiver request¹
- ___ Review of net-fill calculations^{1,2}
- ___ Bridge, culvert or footbridge³
- ___ Retaining wall at least 4 ft high

Major element (\$3,000 plus \$300 per each 100-ft segment of stream)⁴

- ___ Flood hazard limit delineation³
- ___ Stream channel modification^{3,5}
- ___ Stream bank stabilization or protection project³

Major element (\$2,000)

- ___ Bridge or culvert to a private residence or duplex⁶

Minor element (\$1,000 plus \$100 per each 100-ft segment of stream, not to exceed \$4,000)⁴

___ Stream cleaning or pond/lake dredging project⁷

Minor element (\$1,000)

- ___ Utility crossing
- ___ Stormwater outfall structure
- ___ Retaining wall less than 4 ft high
- ___ One private residence or duplex⁶
- ___ Residential addition, garage, shed or barn
- ___ Bridge, culvert or footbridge⁸
- ___ Stream channel modification^{5,8}
- ___ Stream bank stabilization or protection project⁸
- ___ Grading not associated with another project⁸
- ___ Any regulated activity not listed in this table⁸

Minor element (\$500)

- ___ Flood hazard limit delineation^{1,8}

Footnotes for fees:

1. No fee if associated with one private residence or duplex not being constructed as part of a larger residential subdivision.
2. No fee if associated with a bridge or culvert that lies nearly perpendicular to a stream.
3. Provided a review of hydrologic and/or hydraulic calculations is required.
4. Length of stream is measured along centerline of channel.
5. No fee if associated with (and located within 100 ft upstream or downstream of) a new bridge or culvert.
6. Provided private residence or duplex is not being constructed as part of a larger residential subdivision.
7. No fee and different procedure if submitted under "stream cleaning" provisions at N.J.S.A. 58:16A-67. Call DEP for details.
8. Provided no review of calculations is required. Otherwise this is considered a major element.

SECTION #1 (CONT.)

Minor Stream Encroachment Permit Equivalency
Block 124; Lots 1, 2, 3, 4 & 5
Carlstadt Borough, Bergen County, New Jersey
ASGECI #2425

NJDEP DIVISION OF LAND USE REGULATION APPLICATION FORM (LURP #2)



State of New Jersey
Department of Environmental Protection
Division of Land Use Regulation Application Form (LURP-2)
Division of Land Use Regulation
501 E. State Street P O Box 439
Tranton, NJ 08625-0439
www.nj.gov/dep/landuse



ASGECI #2425
MINOR SEP Equivalency

PLEASE PRINT OR TYPE THE FOLLOWING: (Complete all sections unless otherwise noted)

216 Paterson Plank Road Cooperating PRP Group

1. Applicant Name: c/o Golder Associates, attn.: P. Stephen Finn Email: sfinn@golder.com

Address: 200 Century Parkway, Suite C City: Mt. Laurel

State: NJ Zip: 08054 Daytime Phone: 856-793-2005 Ext.: Cell Phone: N/A

2. Agent Name: Amy S. Greene Firm: Amy S. Greene Environmental Consultants, Inc. Email: mail@amvgreene.com

Address: 4 Walter E. Foran Boulevard, Suite 209 City: Flemington

State: NJ Zip: 08822 Daytime Phone: 908-788-9676 Ext.: 12 Cell Phone: N/A

3. Property Owner Name: Borough of Carlstadt Address:

City: State: Zip: Phone: Ext.:

4. Project Name: Paterson Plank Road #216 Superfund Site Site Location (Street Address): 216 Paterson Plank Road

Zip: 07072 Municipality: Carlstadt Borough County: Bergen

Block(s): 124 Lot(s): 1, 2, 3, 4 & 5

N.A.D. 1983 State Plane Coordinates (feet) 6 digits only: (N) 725,193 feet // (E) 610,775 feet

Nearest Waterway: Peach Island Creek Watershed: Hackensack River Subwatershed: Berry's Creek

5. Fees: Total Fee: Fee Waived - See Attached Project Cost: Not Determined Check No: N/A

6. Project Description: Application for a NJDEP Minor Stream Encroachment Permit (Equivalency) for the removal of an existing bulkhead and installation of a new bulkhead landward of the existing wall (see attached).

FOR OFFICIAL USE ONLY

Program Interest # Class Code Activity #

Type Component Type Highlands Yes No

Proposed activity Fees Urban Area Yes No

Date Received / / 20th Day / / 90th Day / /

PRO Project Engineer

Alternate Program Interest ASU ASU Date / /

Program Interest # Class Code Activity #

Type Component Type Fees Pts

Proposed activity

Revised 2/1/2007

7. Application(s) for: (Please check all that apply)

Application Type	Fee Amt.	Amt. Paid
Applicability Determination		
<input type="checkbox"/> Coastal Jurisdictional Determination	N/A	N/A
<input type="checkbox"/> Highlands Jurisdictional Determination		
<input type="checkbox"/> Flood Hazard Waiver/JD	N/A	N/A
CAFRA		
<input type="checkbox"/> Individual Permit		
<input type="checkbox"/> Exemption Request		
<input type="checkbox"/> Permit Modification		
<input type="checkbox"/> General Permit 5		
<input type="checkbox"/> General Permit 6		
<input type="checkbox"/> General Permit 7		
<input type="checkbox"/> General Permit 8		
<input type="checkbox"/> General Permit 9		
<input type="checkbox"/> General Permit 10		
<input type="checkbox"/> General Permit 11		
<input type="checkbox"/> General Permit 12		
<input type="checkbox"/> General Permit 13		
<input type="checkbox"/> General Permit 14		
<input type="checkbox"/> General Permit 15		
<input type="checkbox"/> General Permit 16		
<input type="checkbox"/> General Permit 17		
<input type="checkbox"/> General Permit 18		
<input type="checkbox"/> General Permit 21		
<input type="checkbox"/> General Permit 22		
<input type="checkbox"/> General Permit 23		
<input type="checkbox"/> General Permit 24		
<input type="checkbox"/> General Permit 25		
<input type="checkbox"/> General Permit 26		
<input type="checkbox"/> General Permit 27		
<input type="checkbox"/> General Permit 29		
Consistency Determination		
<input type="checkbox"/> Federal Consistency Determination	N/A	N/A
<input type="checkbox"/> Water Quality Certificate		
Highlands		
<input type="checkbox"/> Emergency Permit		
<input type="checkbox"/> Pre-application Meeting		
<input type="checkbox"/> Preservation Area Approval		
<input type="checkbox"/> PAA with Waiver		
<input type="checkbox"/> Resource Area Determination		
<input type="checkbox"/> General Permit 1		
<input type="checkbox"/> General Permit 2		
Flood Hazard Area		
<input type="checkbox"/> Major Permit		
<input checked="" type="checkbox"/> Minor Permit - Equivalency	Fee Waived	See Attached
<input type="checkbox"/> Modification		
Waterfront Development		
<input type="checkbox"/> General Permit 10		
<input type="checkbox"/> General Permit 14		
<input type="checkbox"/> General Permit 18		
<input type="checkbox"/> General Permit 19		
<input type="checkbox"/> General Permit 20		
<input type="checkbox"/> General Permit 21		
<input type="checkbox"/> Individual Permit/Upland		
<input type="checkbox"/> Individual Permit/Inwater		
<input type="checkbox"/> ZANE Letter		
<input type="checkbox"/> Modification		

Application Type	Fee Amt.	Amt. Paid
Coastal/Tidal Wetlands		
<input type="checkbox"/> Coastal/Tidal Wetlands Permit		
<input type="checkbox"/> Coastal Wetland Permit Modification		
Freshwater Wetlands		
<input type="checkbox"/> Freshwater Wetlands GP1		
<input type="checkbox"/> Freshwater Wetlands GP2		
<input type="checkbox"/> Freshwater Wetlands GP2A		
<input type="checkbox"/> Freshwater Wetlands GP3		
<input type="checkbox"/> Freshwater Wetlands GP4		
<input type="checkbox"/> Freshwater Wetlands GP5		
<input type="checkbox"/> Freshwater Wetlands GP6		
<input type="checkbox"/> Freshwater Wetlands GP7		
<input type="checkbox"/> Freshwater Wetlands GP8		
<input type="checkbox"/> Freshwater Wetlands GP9		
<input type="checkbox"/> Freshwater Wetlands GP10A		
<input type="checkbox"/> Freshwater Wetlands GP10B		
<input type="checkbox"/> Freshwater Wetlands GP10C		
<input type="checkbox"/> Freshwater Wetlands GP11		
<input type="checkbox"/> Freshwater Wetlands GP11A		
<input type="checkbox"/> Freshwater Wetlands GP12		
<input type="checkbox"/> Freshwater Wetlands GP13		
<input type="checkbox"/> Freshwater Wetlands GP14		
<input type="checkbox"/> Freshwater Wetlands GP15		
<input type="checkbox"/> Freshwater Wetlands GP16	N/A	N/A
<input type="checkbox"/> Freshwater Wetlands GP17		
<input type="checkbox"/> Freshwater Wetlands GP18		
<input type="checkbox"/> Freshwater Wetlands GP19		
<input type="checkbox"/> Freshwater Wetlands GP20		
<input type="checkbox"/> Freshwater Wetlands GP20A		
<input type="checkbox"/> Freshwater Wetlands GP21		
<input type="checkbox"/> Freshwater Wetlands GP23		
<input type="checkbox"/> Freshwater Wetlands GP24		
<input type="checkbox"/> Freshwater Wetlands GP25	N/A	N/A
<input type="checkbox"/> Freshwater Wetlands GP26		
<input type="checkbox"/> Freshwater Wetlands GP26A		
<input type="checkbox"/> Freshwater Wetlands GP27		
<input type="checkbox"/> Freshwater GP Modification		
<input type="checkbox"/> Individual Wetlands Permit		
<input type="checkbox"/> Individual Open Water Permit		
<input type="checkbox"/> Individual Permit Modification		
<input type="checkbox"/> Wetlands Exemption		
Letter of Interpretation		
<input type="checkbox"/> Presence Absence		
<input type="checkbox"/> Presence Absence Footprint		
<input type="checkbox"/> Delineation		
<input type="checkbox"/> Verification		
<input type="checkbox"/> Extension		
Transition Area Waiver		
<input type="checkbox"/> Averaging Plan		
<input type="checkbox"/> Reduction		
<input type="checkbox"/> Hardship Reduction		
<input type="checkbox"/> Special Activity Stormwater		
<input type="checkbox"/> Linear Development		
<input type="checkbox"/> Redevelopment		
<input type="checkbox"/> Individual Permit		
<input type="checkbox"/> Exemption		
<input type="checkbox"/> Modification		

Both the Applicant and Property owner's section must be filled out for all Land Use Regulation Applications

A. APPLICANT SIGNATURE

I certify under penalty of law that the information provided in this document is true and accurate. I am aware that there are significant civil and criminal penalties for submitting false or inaccurate information. (If corporate entity, print/type the name and title of person signing on behalf of the corporate entity.)

Signature of Applicant/Owner

Signature of Applicant/Owner

Date

Date

P. Stephen Finn, C. Eng.
216 Paterson Plank Road Cooperating PRP
Group, c/o Golder Associates

Print Name

Print Name

200 Century Parkway, Suite C
Mt. Laurel, NJ 08054

Print Address

Print Address

B. PROPERTY OWNER'S CERTIFICATION

I hereby certify that the undersigned is the owner of the property upon which the proposed work is to be done. This endorsement is certification that the owner grants permission for the conduct of the proposed activity. In addition, I hereby give unconditional written consent to allow access to the site by representatives or agents of the Department for the purpose of conducting a site inspection or survey of the project site.

In addition, the undersigned property owner hereby certifies:

1. Whether any work is to be done within an easement – Yes: ☐ No: ☐
2. Whether any part of the entire project (e.g., pipeline, roadway, cable, transmission line, structure, etc.) will be located within property belonging to the State of New Jersey-Yes: ☐ No: ☐
3. Whether any work is to be done on any property owned by any public agency that would be encumbered by Green Acres – Yes: ☐ No: ☐
4. Whether any part of this project requires a Section 106(National Register of Historic Places) Determination as part of a federal permit or approval – Yes: ☐ No: ☐

Signature Requirement Waived – See Attached

Signature of Owner

Signature of Owner

Date

Date

Print Name

Print Name

Print Address

Print Address

C. **APPLICANT'S AGENT**

NOTE: Notary seal is required for Flood Hazard Area (SEA) applications.

I, P. Stephen Finn, the Applicant, authorize to act as my agent/representative in all matters pertaining to my application the following person:

Name Amy S. Greene

Occupation/Profession President, Amy S. Greene Environmental Consultants, Inc.

(Signature of Applicant/Owner)

AGENT'S CERTIFICATION

Sworn before me this day of

I agree to serve as agent for the above-mentioned applicant

_____ 20 ____

(Signature of Agent)

Notary Public

D. **STATEMENT OF PREPARER OF PLANS, SPECIFICATIONS, SURVEYOR'S OR ENGINEER'S REPORT**

I hereby certify that the plans, specifications and engineer's report, if any, applicable to this project comply with the current rules and regulations of the New Jersey Department of Environmental Protection with the exceptions as noted.

Signature

Mark F. McNeilly, P.E.

Type: Name and Date

Senior Consultant, Golder Associates, Inc.

Position, Name of Firm

E. **STATEMENT OF PREPARER OF APPLICATION, REPORTS AND/OR SUPPORTING DOCUMENTS (other than engineering)**

I certify under penalty of law that I have personally examined and am familiar with the information submitted in the document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining and preparing the information, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment.

Signature

Amy S. Greene

Type: Name and Date

President, Amy S. Greene Environmental Consultants, Inc.

Position, Name of Firm

SECTION #1 (CONT.)

Minor Stream Encroachment Permit Equivalency
Block 124; Lots 1, 2, 3, 4 & 5
Carlstadt Borough, Bergen County, New Jersey
ASGECI #2425

ATTACHMENT FOR ITEM #6 OF LURP #2 FORM – PROJECT DESCRIPTION

1. Introduction

This permit equivalency is submitted to demonstrate completion of the substantive requirements of the New Jersey Department of Environmental Protection (NJDEP), Division of Land Use Regulation, Minor Stream Encroachment Permit program for the remediation of the Paterson Plank Road Superfund Site, located in the Borough of Carlstadt, Bergen County, New Jersey (see Section #3 – Figures 1 and 2). Specifically, the project entails stabilization of the stream bank along Peach Island Creek by replacement of the existing bulkhead along Peach Island Creek with a new bulkhead to be installed landward of the existing bulkhead.

The property consists of approximately 5.9 acres and is within the regulatory boundaries of the New Jersey Meadowlands Commission. Route 120 (Paterson Plank Road) and Gotham Parkway abut the southwestern and northwestern site boundaries, respectively. Peach Island Creek runs along the northeastern site boundary (refer to Section # 3; Figures 1-4). Peach Island Creek forms the northern site boundary. Peach Island Creek drains to Berry's Creek, which eventually flows to the Hackensack River. Peach Island Creek is a tidal creek and has been given an NJDEP Surface Water Quality Classification (N.J.A.C. 7.9B) of FW2-NT/SE2, for a waterway in which a saltwater/freshwater interface occurs. A portion of the site is located below the 100-year Federal Emergency Response Agency (FEMA) floodplain elevation (7.2 feet). The floodway is presumed to be confined to the existing channel of Peach Island Creek. No activities are proposed in the floodway of Peach Island Creek or below the Mean High Water (MHW) elevation.

Historically, the subject parcel was purchased in 1941 by Patrick Marrone, who utilized the land for solvent refining and solvent recovery. Mr. Marrone eventually sold the parcel to a predecessor of Inmar Associates, Inc. (exact date unknown). Aerial photographs indicate drummed materials were stored on the site during the 1950s, 1960s, and 1970s. Inmar Associates leased the property to SCP, Inc. (SCP), who utilized the site for processing industrial wastes from 1971 until the company was forced to shut down by a court order in 1980.

An interim plan for site remediation was implemented in 1992 in accordance with a Record of Decision, dated September 14, 1990, issued by the US Environmental Protection Agency (USEPA). The interim remedy forms the First Operable Unit (OU-1) and consists of a geomembrane cover, a composite slurry wall surrounding the site and a recovery system for shallow groundwater. As part of the interim plan, a steel sheet pile bulkhead was installed along Peach Island Creek. The bulkhead extends approximately 3-4 feet above the water surface and separates the site from Peach Island Creek.

The selected remedy for the Second Operable Unit (OU-2), as required by USEPA's Record of Decision dated August 12, 2002, includes installing a final low permeable cap; in-situ treatment of a sludge "hot spot"; upgrading the existing groundwater recovery system; and streambank enhancements to improve stability along Peach Island Creek. The 100% Design Report (Golder, 2007) proposes to replace the sheet pile with a new bulkhead approximately five feet landward of the existing wall, which will provide stabilization to the stream bank along Peach Island Creek.

Details of proposed activities are provided below under Item No. 3, Scope of Work.

2. Scope of Work

The Remediation of the 216 Paterson Plank Road Superfund site is being performed in order to protect human health and the environment by a combination of treatment and preventing direct contact with contaminated waste. The combination of the in-situ "hot spot" treatment, hazardous waste cap, new sheet pile bulkhead, groundwater recovery system, and a perimeter security fence will eliminate site risks by limiting the off-site migration of contaminants and restricting access to the site. The remedial activities are described below.

Sheet Pile Wall

The existing sheet pile wall, located along the site's northeastern perimeter (i.e., along Peach Island Creek), was installed circa 1992 in accordance with USEPA's Record of Decision dated September 14, 1990. Pursuant to USEPA's Record of Decision dated August 12, 2002, a new sheet pile wall will be installed approximately five feet landward of the existing wall.

The new sheet pile wall will be installed to between 30 feet (minimum) and 40 feet (maximum) below ground surface. The top of the sheet pile wall will have an elevation of approximately six feet (the existing sheet pile wall has an elevation of three to four feet above water surface). The proposed sheet pile wall will be installed in the following sequence:

1. Install new sheet pile wall approximately five feet landward of the existing wall;
2. Remove materials between the existing and new sheet pile walls to an approximate elevation of -2.0 feet and backfill with crushed stone to an approximate elevation of -1.0 feet; and
3. Remove/cut the existing sheet pile wall at the mud line of Peach Island Creek (i.e., approximate elevation of -1.0 feet).

The new bulkhead wall shall contain a series of six weirs for the discharge of surface waters collected onsite via perimeter drainage channels; Refer to Figures 13 and 14 of the 100% Design Report. Please note, the northeast perimeter drainage channel will abut the new bulkhead; see Figure 5 – Grading and Drainage Detail of the 100% Design Report.

No impacts to Waters of the US are anticipated as a result of the proposed sheet pile wall installation/removal activities.

In-Situ "Hot Spot" Treatment

One of the primary remedial action goals for OU-2 is to reduce the toxicity and mobility of the contaminants associated with the existing sludge "hot spot". The selected remedy for this area includes in-situ treatment methods, including air stripping and in-situ solidification/stabilization (ISS) technologies; refer to Figure 8 of the 100% Design Report.

Air stripping will be utilized to promote volatilization and removal of chemical constituents (primarily volatile organic compounds) within the existing fill and sludge materials. This will be accomplished by mixing the existing fill and sludge in-place while injecting air or steam to enhance volatilization and removal processes. The extracted off-gas will be captured and treated using appropriate technologies (e.g., vapor phase activated carbon, thermal oxidation, catalytic oxidizers) prior to release to the atmosphere.

Subsequent to air stripping activities, the air stripped fill and sludge materials will be injected with admixtures, such as cement, lime or fly ash, to stabilize and solidify the material to control the overall mobility of the remaining chemical constituents.

Fencing

A new fence will be constructed along the northeastern perimeter of the Site (i.e., along Peach Island Creek) and will be attached directly to the new sheet pile wall. The existing fence located along the southeastern perimeter will be restored, as necessary.

Perimeter Access Road

The proposed access road will be constructed on the northeast, northwest, southeast and southwest sides of the site. The perimeter road will be constructed of 6" dense-graded aggregate, underlain by 500x woven geotextile and will be approximately 15-feet in width; refer to Figures 5 and 6 of the 100% Design Report for details.

The proposed road is intended to allow post-closure access for operations and maintenance activities associated with the groundwater extraction system, such as sample collection and repairs.

Capping System

The final cap consists of (listed from the top down): 6-inch thick vegetative support top soil layer, 18-inch thick soil cover layer, geocomposite drainage layer, 40-mil geomembrane, a geosynthetic clay liner layer, and grading fill (varying thicknesses).

Upon completion of the cap construction, the cap will be revegetated in order to control the potential for erosion, thereby protecting the stability of the final cap.

Groundwater Extraction

The project proposes the installation of new groundwater extraction wells and new piezometers as part of the groundwater recovery system plan. The wells will be installed along the perimeter of the site at depths ranging from 10 to 13 feet below ground surface. The new piezometers will

be installed along the perimeter of the site on both sides of the existing slurry wall. Refer to Figures 9-12 of the 100% Design Report.

Surface and Stormwater Management

The surface water at the site is currently collected in a series of drainage channels, including a centrally located natural drainage divide that traverses the site in an east to west direction. The surface water runoff is collected in the perimeter drainage channels surrounding the site, which discharge either directly or eventually into Peach Island Creek.

The project proposes to upgrade and/or construct a perimeter drainage channel to manage surface water and route cap runoff to minimize erosion of the cover and expedite the removal of runoff. The surface water runoff will be discharged directly into Peach Island Creek through a series of six weirs in the sheet pile bulkhead (refer to Figure 13 – Sheet Pile Wall Plan and Figure 14 – Sheet Pile Wall Detail of the 100% Design Report).

Stormwater management rules do not apply to the proposed project; refer to Section #2 N.J.A.C. 7:13-2.8 Stormwater Management and Water Quality for details.

Demolition Activities

Several existing groundwater monitoring wells, groundwater extraction wells and discharge headers, piezometers, onsite structures, fences and sheet pile wall bulkhead will be removed as part of the proposed project. Refer to Figure 15 – Demolition Plan of the 100% Design Report, for details.

Project Schedule

The project schedule is presented in the 100% Design Report (Figure 19) and is dependant on USEPA approval of the Final (100%) Design Report.

3. Summary of Disturbance

The site is currently overlain by an impervious plastic membrane cover that does not support vegetation.

Field investigations conducted by ASGECI in October 2004 indicated that no freshwater wetlands were identified on the project site; therefore, no impacts to wetlands are anticipated. Please refer to the environmental report N.J.A.C. 7:13-3.8 Wetlands Section for our findings.

The proposed project will result in a total disturbance to approximately 5.9 acres of land; however, the disturbance will be temporary for the duration of the remediation activities and all areas will be restored with vegetation following project completion.

SECTION #2

Minor Stream Encroachment Permit Equivalency
Block 124; Lots 1, 2, 3, 4 & 5
Carlstadt Borough, Bergen County, New Jersey
ASGECI #2425

ENVIRONMENTAL REPORT

SITE INFORMATION:

Acreage: +/- 5.94 acres

Legal Designation: Block 124; Lots 1, 2, 3, 4 & 5
Carlstadt Borough
Bergen County, New Jersey

Applicant: 216 Paterson Plank Road Cooperating PRP Group
c/o 200 Century Parkway, Suite C
Mt. Laurel, NJ 08054
(856) 793-2006
Attn.: P. Stephen Finn, C. Eng.

Property Owner: Borough of Carlstadt
500 Madison Street
Carlstadt, New Jersey 07072

Engineer: Golder Associates, Inc.
The National Newark Building
744 Broad Street, 25th Floor
Newark, NJ 07102
(973) 621-0777
Attn.: Mark F. McNeilly, P.E.

NJ State Plane Coordinates: For the approximate center of the site:
North: 725,193 feet East: 610,775 feet

USGS Quadrangle: Weehawken NJ/NY Quadrangle

Nearest Waterway: Peach Island Creek
Drainage Basin: Berry's Creek
Drainage System: Hackensack River

Water Quality Classification: Freshwater, Non-Trout, Saline Estuary (FW2-NT/SE2)

SECTION #2 (CONT.)

Minor Stream Encroachment Permit Equivalency
Block 124; Lots 1, 2, 3, 4 & 5
Carlstadt Borough, Bergen County, New Jersey
ASGECI #2425

**COMPLIANCE WITH ENVIRONMENTAL REPORT REQUIREMENTS
LISTED AT N.J.A.C. 7:13-4.1(j)****Project Description and Scope (N.J.A.C. 7:13-4.1(j)1)**

Please refer to the Project Description as contained above in Section 1 of this application.

The property concerned is being remediated under the requirements of the CERLA (Superfund) law. As such, a detailed Feasibility Study of alternatives was completed for this site. The required evaluation of alternatives was based on nine criteria required by law, which include consideration of short-term and long-term effects. Based on this evaluation and subsequent to comprehensive review by the EPA, the remedy outlined in the 100% Design Report, which minimizes any impact on Peach Island Creek, was selected by EPA with concurrence from the NJDEP. The EPA has mandated this remedy in a Record of Decision.

Temporary and Permanent Physical Changes (N.J.A.C. 7:13-4.1(j)2)

The project will result in a total disturbance to approximately 5.9 acres of land; however, the disturbance will be temporary for the duration of the remediation activities. All areas will be stabilized and vegetated immediately following project completion.

Permanent changes include new grading of the site as a result of the final cap; a new perimeter drainage channel; and a new bulkhead landward of the existing wall (which is to be removed).

Effect on Public Health, Safety, and Welfare (N.J.A.C. 7:13-4.1(j)2i)

The proposed project will have a positive effect on public health, safety, and welfare because it will provide final, proper closure of the Paterson Plank Road Superfund Site, which in turn will prevent accidental release of contaminants into the surrounding area and waterways.

Project Location and State Plane Coordinates (N.J.A.C. 7:13-4.1(j)3)

The project area is located within Block 124, Lots 1 through 5 along Paterson Plank Road in Carlstadt Borough, Bergen County, New Jersey. The state plane coordinates for the approximate center of the site is (N) 725,193' // (E) 610,775'. Please refer to Figures 1 and 3 in Section #3 of this application for a copy of a municipal tax map and USGS project location map with State Plane Coordinate locations.

Detention and Retention Basins (N.J.A.C. 7:13-4.1(j)5)

There are no detention or retention basins proposed in association with the project. The installation of a drainage channel is proposed along the perimeter of the site, which would discharge surface waters directly into Peach Island Creek through a series of six weirs consistent with existing drainage patterns. Refer to Figure 4 – Grading and Drainage Plan and Figure 5 – Grading and Drainage Details of the 100% Design Report, for further details.

Threatened and Endangered Species Survey (N.J.A.C. 7:13-4.1(j)7)

According to the New Jersey Landscape Project, no habitat for threatened and endangered species was identified on or in the vicinity of the site.

Database searches (Section #5) were conducted by the New Jersey Natural Heritage ("NHP") to ascertain whether State or Federally-listed threatened or endangered species, critical habitat, or rare natural communities have been recorded for the area within one-half mile of the site as per the Endangered and Nongame Species Conservation Act (N.J.S.A. 23:2A-1 et seq.) and the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), respectively.

As stated in a letter dated April 12, 2007, the NHP does not have any records of rare plants, animals or ecological communities on the site. The NHP does, however, have records of northern harrier (*Circus cyaneus*, Endangered), colonial waterbird foraging habitat, and yellow-crowned night-heron (*Nyctanassa violacea*, Threatened) foraging habitat within one half mile of the site

The proposed project is not anticipated to impact directly or indirectly upon an endangered or threatened species or their known habitat.

ENVIRONMENTAL REVIEW ELEMENTS:

STATEMENT OF COMPLIANCE WITH NJ FLOOD HAZARD AREA CONTROL ACT (N.J.A.C. 7:13) ENVIRONMENTAL STANDARDS

N.J.A.C. 7:13-2.5 Watercourse Cleaning

The proposed project will not include or require routine watercourse cleaning or watercourse cleaning permits.

N.J.A.C. 7:13-3.5 & 3.6 Fish Protection and Low Flow Fish Passage (also N.J.A.C. 7:13-4.1(j)4)

Not applicable. No activities in the creek are proposed. The proposed project will not alter the hydrology or flood elevations of Peach Island Creek.

N.J.A.C. 7:13-2.16(c) Bridges and Culverts

No bridges or culverts are proposed as a part of this project; therefore, this rule does not apply.

N.J.A.C. 7:13-2.9 & 3.6(c) Channel Modification

No channel modification is proposed as a part of this project.

N.J.A.C. 7:13-3.7 Acid Soils (also N.J.A.C. 7:13-4.19(j)6)

The project area is located in Bergen County, which does not lie above a geologic formation commonly associated with acid producing soils; therefore, acid producing soils are not expected to be encountered. The material to be removed from behind the existing bulkhead will be properly disposed of. The Site will be capped with 18 inches of cover soil and 6 inches of topsoil.

N.J.A.C. 7:13-3.5 Projects Along Trout Associated Watercourses

Peach Island Creek has been given a surface water quality classification of freshwater non-trout, FW2-NT/SE2-C2, or a waterway in which a saltwater/freshwater interface occurs. The site is not located less than or equal to one mile upstream of trout production or trout maintenance waters. Therefore, the proposed project will have no impacts to trout associated watercourses.

N.J.A.C. 7:13-3.6 Projects Affecting other Fish Resources

As stated above, Peach Island Creek drains to Berry's Creek, which eventually flows to the Hackensack River. Anadromous fish species, including the river herring (alewife, *Alosa pseudoharengus* and blueback herring, *Alosa aestivalis*) and American shad, have previously confirmed spawning runs within the Hackensack River at Oradell Reservoir Dam in Jersey City (Zich, 1978). No work in the waterway is proposed.

N.J.A.C. 7:13-3.2 Near Watercourse Vegetation Protection

Although activities are proposed within 25 feet of the top of bank, clearing of vegetation is not required. With exception to the few individual plants observed within the existing plastic-lined drainage channel, no vegetation occurs within 25 feet of the top of bank or along Peach Island Creek. The entire site is covered with a plastic membrane. Vegetation identified within ponded areas of the drainage channel includes spike rush (*Eleocharis* spp.), rice cutgrass (*Leersia oryzoides*, OBL), common cattail (*Typha* spp.), and common reed grass (*Phragmites australis*, FACW).

Proposed activities within 25 feet of the top of bank include the following:

- Installation of a new sheet pile wall bulkhead, which will be placed approximately five feet landward of the existing bulkhead;
- Removal of existing bulkhead and materials in between sheet pile walls;
- Demolition of existing fence along northeastern perimeter of site (i.e., along Peach Island Creek) and installation of new fence in same location;
- Construction of a perimeter drainage channel; and

- Construction of perimeter access road, consisting of 6" dense aggregate.

Subsequent to the completion of the proposed project, the final cap will be covered with 18 inches of permeable material and 6 inches of topsoil then seeded with vegetation to provide soil stabilization, reduce runoff, promote evapotranspiration and onsite detention, and possibly provide wildlife habitat.

Please refer to Section #1, Project Description, for details on the above listed activities.

N.J.A.C. 7:13-3.3 Soil Erosion and Sediment Control

All disturbance activities proposed for the project will be performed in accordance with the "Standards for Soil Erosion and Sediment Control in New Jersey" promulgated by the New Jersey State Soil Conservation Committee pursuant to the Soil Erosion and Sediment Control Act of 1975 as amended, N.J.S.A. 4:24-42 et seq. and N.J.A.C. 2:90. The area of soil disturbance shall be no larger than that which is absolutely necessary for the construction activity.

A Soil Erosion and Sediment Control Plan has been prepared and is included with this application; refer to Figure 6 – Soil Erosion and Sediment Control Plan and Figure 7 – Soil Erosion and Sediment Control Details of the 100% Design Report.

N.J.A.C. 7:13-2.8 Stormwater Management and Water Quality

The Stormwater Management rules at N.J.A.C. 7:8 require that stormwater management be provided for "major" projects. Major projects are defined as projects that result in one-quarter acre or more increase in impervious surface or one acre of overall disturbance. The existing site is predominantly impervious as it is covered with a plastic membrane. The proposed project will result in a total disturbance to approximately 5.9 acres of land; however the disturbance will be temporary for the duration of the remediation activities, and all areas will be restored with vegetation following project completion. Additionally, the project engineer has incorporated non-structural stormwater management strategies by grading the remediation site to a gentle slope that disperses stormwater, rather than concentrating stormwater. The final cap design includes at least two feet of soil that will be vegetated, which will likely increase the rain infiltration rates, encourage onsite detention and evapotranspiration, and provide stabilization for the site overall. Surface water runoff will be collected in a drainage channel that encircles the site and discharged directly into Peach Island Creek through a series of six weirs.

The following sections describe the stormwater management rules with respect to recharge, quantity, and quantity and the applicability of these rules to the project.

Recharge

In accordance with N.J.A.C. 7:8-5.4(a)1.iii, stormwater shall not be recharged in, "areas where recharge would be inconsistent with Department approved remedial action work plan or

landfill closure plan.” Because the purpose of the remedial action is to minimize recharge into waste materials, there is no proposed stormwater recharge to groundwater following project completion. Therefore, the proposed stormwater management design complies with NJDEP rules pertaining to recharge.

Quantity

According to N.J.A.C. 7:8-5.4 (a)3.iv., “In tidal flood hazard areas, stormwater runoff quantity analysis ... shall only be applied if the increased volume of stormwater runoff could increase flood damages below the point of the discharge.” The existing site is impervious and covered with a plastic membrane. The proposed final cap will be overlain with 24 inches of pervious material, including 6 inches of topsoil, and will have gentle slopes. The post-construction runoff will likely be less than pre-construction volumes and rates since the site is currently covered with a plastic membrane, with no soil cover.

Quality

In accordance with N.J.A.C. 7:8-5.5(a), “...stormwater management measures shall only be required for water quality control if an additional one-quarter acre of impervious surface is being proposed on a development site...” The site is currently impervious due to the presence of the plastic membrane cover. There are no new impervious surfaces proposed as part of this remediation project. Therefore, there will be no increase in post construction load of total suspended solids in stormwater generated from the project site and no requirement to address treatment of stormwater runoff quality.

Erosion Control

The design and performance standards for erosion control are those established under the Soil Erosion and Sediment Control act (N.J.S.A. 4:24-39 et seq.). A Soil Erosion and Sediment Control Plan will be implemented for the project and is provided in Figures 6 & 7 of the 100% Design Report.

Therefore, the review of stormwater recharge, quantity or quality measures is not required for the proposed project.

N.J.A.C. 7-13-2.7 Disposal of Spoils

No material will be dredged from the channel of Peach Island Creek. The fill material between the proposed bulkhead and the existing bulkhead will be placed on the site then covered with the geomembrane and cover soil. No material will be disposed of in the floodway.

N.J.A.C. 7:13-3.8 Wetlands

No wetlands are located on the project site; therefore, this rule does not apply.

ASGECI performed a wetland investigation of the site in October 2004. Existing published information was studied to determine the approximate extent of wetlands and a field investigation was performed at the site by ASGECI in October 2004. Vegetation, soils, and

hydrology were examined for evidence of wetland characteristics according to methodology outlined in the Corps of Engineers Wetlands Delineation Manual (Department of the Army, US Army Corps of Engineers, 1987). In order to be identified as wetlands, an area must have hydrophytic vegetation, hydric soils, and be saturated by groundwater or inundated by surface water for a significant portion of the growing season.

No wetlands were identified during the site investigation in October 2004; however, Peach Island Creek was identified as Waters of the U.S. Peach Island Creek abuts the site's northern perimeter. The limits of Peach Island Creek, as well as the Mean High Water (MHW) line and 100-year floodplain elevation (7.2 feet), are shown on site plans included with the 100% Design Report.

A. Vegetation

No wetland or upland vegetation was identified along Peach Island Creek. A drainage swale, constructed to convey stormwater and lined with a plastic membrane, encircles the project site. A few individual plants were identified in several ponded areas within a plastic-lined ditch, including spike rush (*Eleocharis* spp.), rice cutgrass (*Leersia oryzoides*), common cattail (*Typha* spp.), and common reed grass (*Phragmites australis*). No additional vegetation is found onsite, the site is covered entirely with the plastic membrane cap.

B. Soils

According to the Soil Survey Geographic (SSURGO) Database for Bergen County (Section 3, Figure 4), the soil type identified within the project area is listed as Urban Land (UR). This unit is characterized by areas that have been cut or filled as a result of development and covered with an impervious surface, such as buildings or pavement. The original soil profile is often indistinguishable.

The site is currently covered by a plastic membrane, therefore no hydric soils are present.

C. Hydrology

A plastic-lined stormwater conveyance swale encircles the project site, which discharges directly into Peach Island Creek. Peach Island Creek abuts the northeastern property boundary. Peach Island Creek drains to Berry's Creek, which eventually flows to the Hackensack River. No wetlands were identified along Peach Island Creek due to the presence of a sheet pile wall bulkhead. Areas adjacent to the bulkhead were identified as Waters of the U.S.

Based upon review of FEMA floodplain mapping, portions of the site are located within the 100-year floodplain elevation (7.2 feet).

D. Resource Value Classification

No wetlands were identified within the project site. Although some hydrophytic vegetation was observed within the plastic-lined drainage channels onsite, these areas should not be regulated as "jurisdictional wetlands" since it formed as a result of shallow ponding atop the existing plastic membrane. In addition, hydric soils and long-term hydrology were not observed throughout the project site. The tidal Peach Island Creek, which abuts the northeastern site boundary, was identified as Waters of U.S.

Threatened and endangered species (N.J.A.C. 7:13-3.9)

According to the New Jersey Landscape Project, no habitat for threatened and endangered species was identified on or in the vicinity of the site.

Database searches (Section #5) were conducted by the New Jersey Natural Heritage ("NHP") to ascertain whether State or Federally-listed threatened or endangered species, critical habitat, or rare natural communities have been recorded for the area within one-half mile of the site as per the Endangered and Nongame Species Conservation Act (N.J.S.A. 23:2A-1 et seq.) and the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), respectively.

As stated in a letter dated April 12, 2007, the NHP does not have any records of rare plants, animals or ecological communities on the site. The NHP does, however, have records of northern harrier (*Circus cyaneus*, Endangered), colonial waterbird foraging habitat, and yellow-crowned night-heron (*Nyctanassa violacea*, Threatened) foraging habitat within one half mile of the site

The proposed project is not anticipated to impact directly or indirectly upon an endangered or threatened species or their known habitat.

SECTION #3

Minor Stream Encroachment Permit Equivalency

Block 124; Lots 1, 2, 3, 4 & 5

Carlstadt Borough, Bergen County, New Jersey

ASGECI #2425

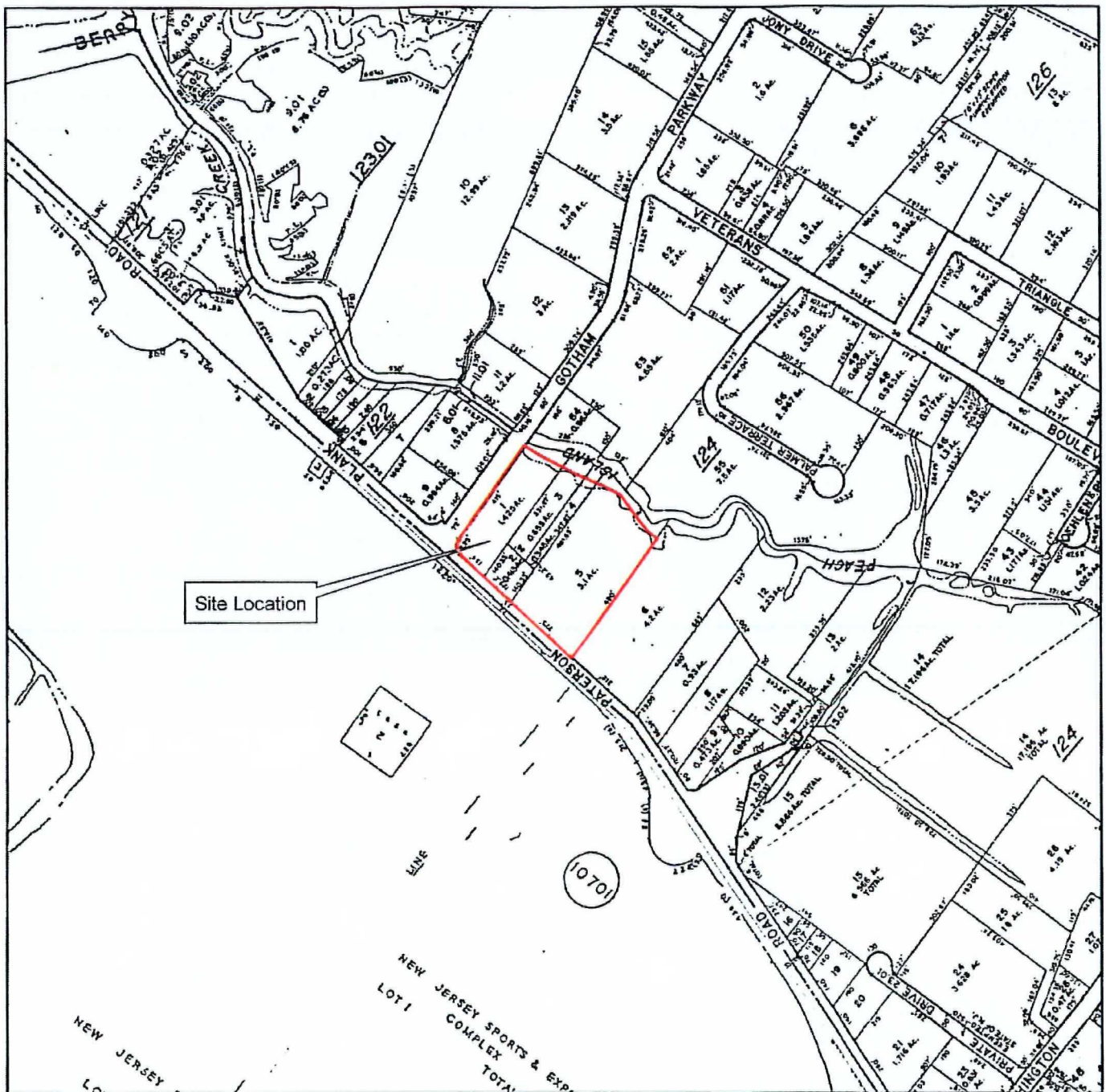
SITE FIGURES

Figure 1 – Municipal Tax Map

Figure 2 – County Road Map

Figure 3 – USGS Topographic Map

Figure 4 – SSURGO Soils Map



Site Location

Legend

 Site Location

Note: Map not to scale

Quadrangle
Location



Figure 1 Municipal Tax Map

Block 124; Lots 1,2,3,4, and 5
Borough of Carlstadt
Bergen County, New Jersey

ASGECI Project #2425

Sources:
Municipal Tax Map for Carlstadt Borough, Bergen County, New Jersey, Sheets 8 and 9,
prepared by J.P. Azzolina, last revised by Sabetay Behar, P.L.S., December 1992.
Municipal Tax Map for East Rutherford Borough, Bergen County, New Jersey, Sheets 9, 10, and 12,
prepared by William B. Klapper, P.L.S., last revised November 1990.

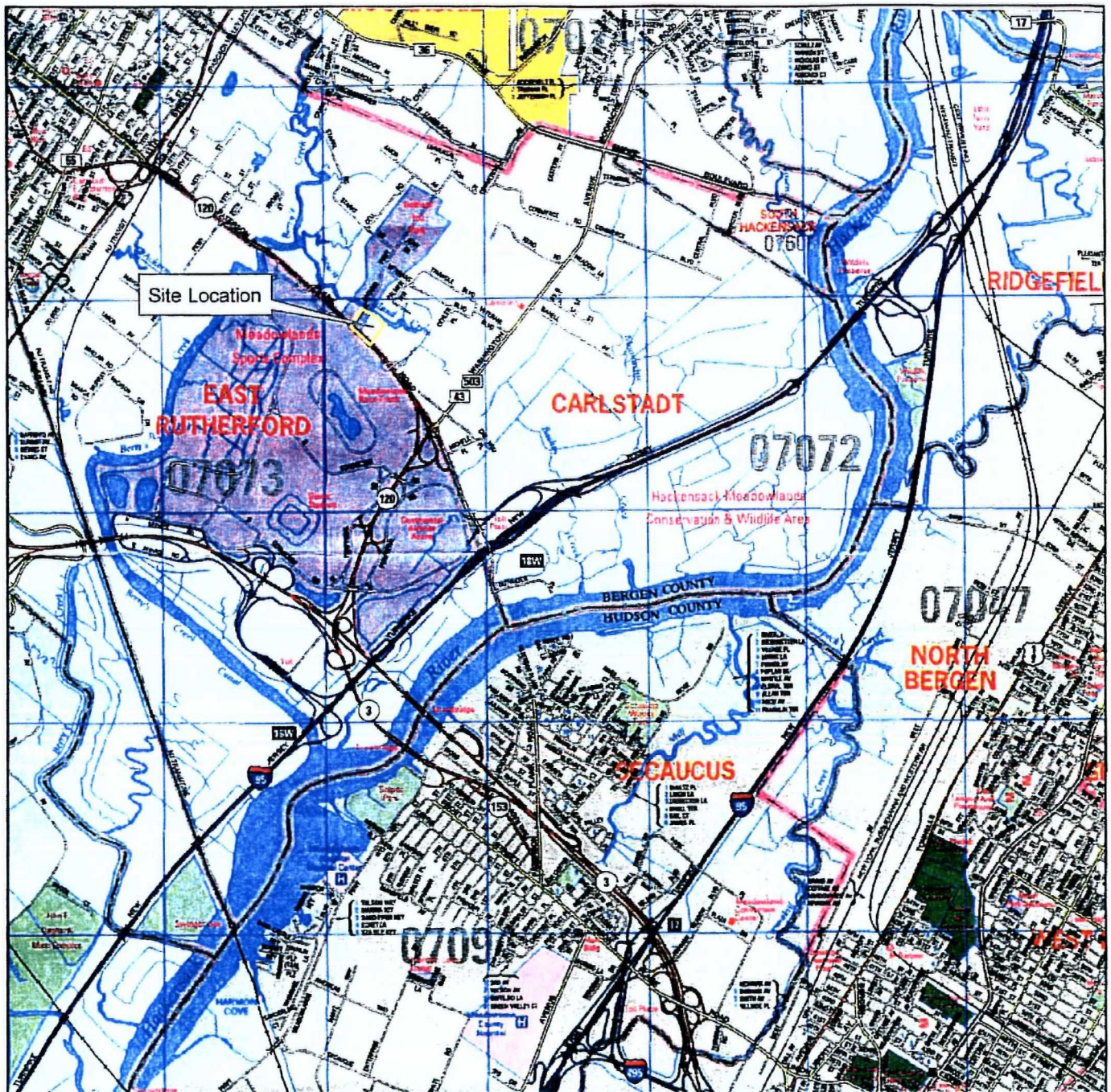
AMY S. GREENE
ENVIRONMENTAL
CONSULTANTS.

LIST OF LOT AND BLOCK NUMBERS

BLOCK	LOT	OWNER INFORMATION
121	3	SPANISH RADIO/HEFTEL 485 MADISON AVENUE 3 RD FLOOR NEW YORK NY 10022
122	2	BOROUGH OF CARLSTADT 500 MADISON STREET CARLSTADT NJ 07072
	3	WILLIAMS, ESTATE, JAMES WILLIAMS P.O. BOX 257 COOPER STN NY 10276
	4	JESSIE DAVANZO 63 WHITE OAK DR PARSIPPANY NJ 07054
	5	GRELLA-PRESTO ENTERPRISES 18 GLEN RD RUTHERFORD NJ 07070
	6	DONABLE LLC 72 HIGGINS PL HARRINGTON PK NJ 07640
	7	266 PAT. AVE. CORP./HACKENSACK STEEL 645 INDUSTRIAL RD. CARLSTADT NJ 07072
	8	GOTHAM/BURR WOLFF L.P. P.O. BOX 2818 ALPHARETTA GA 30023
	9	GOTHAM/BURR WOLFF L.P. P.O. BOX 2818 ALPHARETTA GA 30023
123.01	9.01	H.B.C. NEW YORK 277 PATERSON PLK. RD. CARLSTADT, NJ 07072
	10	YELLOW EQUIPMENT/REAL ESTATE DEPT. 10990 ROE AVE OVERLAND PARK, KANSAS 66211
	11	AMB/01-4597-250 RE TAX COORDINATOR 60 STATE STREET STE 1200 BOSTON MA 02109
	12	LOUMAR ASSOC.SCHWARTZ, M/TELEKY 280 WILSON AVE NEWARK NJ 07105
	13	ARTHRA HOLDINGS LLC 430 GOTHAM PARKWAY CARLSTADT NJ 07072

123.01	14	480 GOTHAM PARKWAY GPA LLC PARK 80 WEST PLAZA II SADDLE BROOK NJ 07663
	15	AMB/01-4597-250 RE TAX COORDINATOR 60 STATE STREET STE 1200 BOSTON MA 02109
	16	VACANT LAND BOROUGH OF CARLSTADT
	17	AMB/01-4597-250 RE TAX COORDINATOR 60 STATE STREET STE 1200 BOSTON MA 02109
	27	AMB/01-4597-760 RE TAX COORDINATOR P.O. BOX 7509 HICKSVILLE NY 11802-7509
	28	TEWANI GROUP, LLC, 39 STARKE RD/UNIT 3 CARLSTADT
124	46	194 VETERANS BLVD LLC % WILSON ASSOC. PARK 80 WEST SADDLE BROOK NJ 07663
	47	AMB/01-4597-250 RE: TAX COORDINATOR 60 STATE ST. STE 1200 BOSTON MA 02109
	48	425 GOTHAM PARKWAY LLC % WILSON ASSOC. PARK 80 WEST SADDLE BROOK NJ 07663
	49	325 GOTHAM PARKWAY LLC % WILSON ASSOC. PARK 80 WEST SADDLE BROOK NJ 07663

Property across Paterson Plank Road, not shown on the tax map, is owned by the Meadowlands Sports Authority.



Legend

 Site Location

Note: Map not to scale



Quadrangle
Location




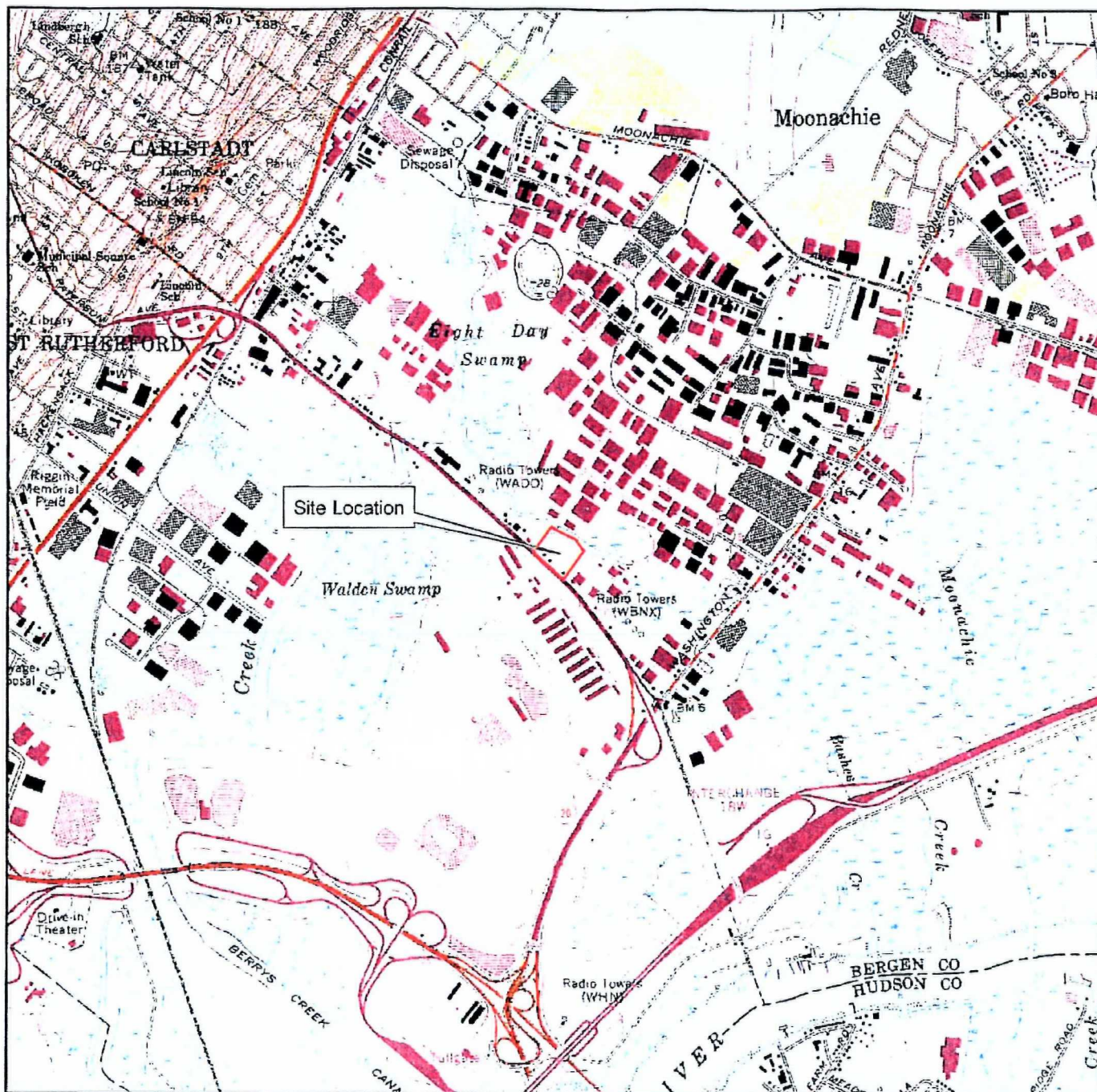
Figure 2 County Road Map

Block 124; Lots 1,2,3,4, and 5
Borough of Carlstadt
Bergen County, New Jersey

ASGECI Project #2425

Sources:
Bergen County, New Jersey Street Map, Hagstrom Map Company, Inc., Maspeth, New York, 2002.

 AMY S. GREENE
ENVIRONMENTAL
CONSULTANTS.



Legend



Site Location

New Jersey State Plane Coordinates for
the approximate center of the site location:

North: 725,193' // East: 610,775'



Quadrangle
Location

Source:

Bit-Mapped 7.5 Minute Color Topographic Images of New Jersey, United States Geological Survey (USGS), Digital
Raster Graphic (DRG) Topographic Series Map, Weehawken, N.J.-N.Y. Quadrangle, USGS, Reston, Va., January 9, 1998.



Figure 3 USGS Topographic Map

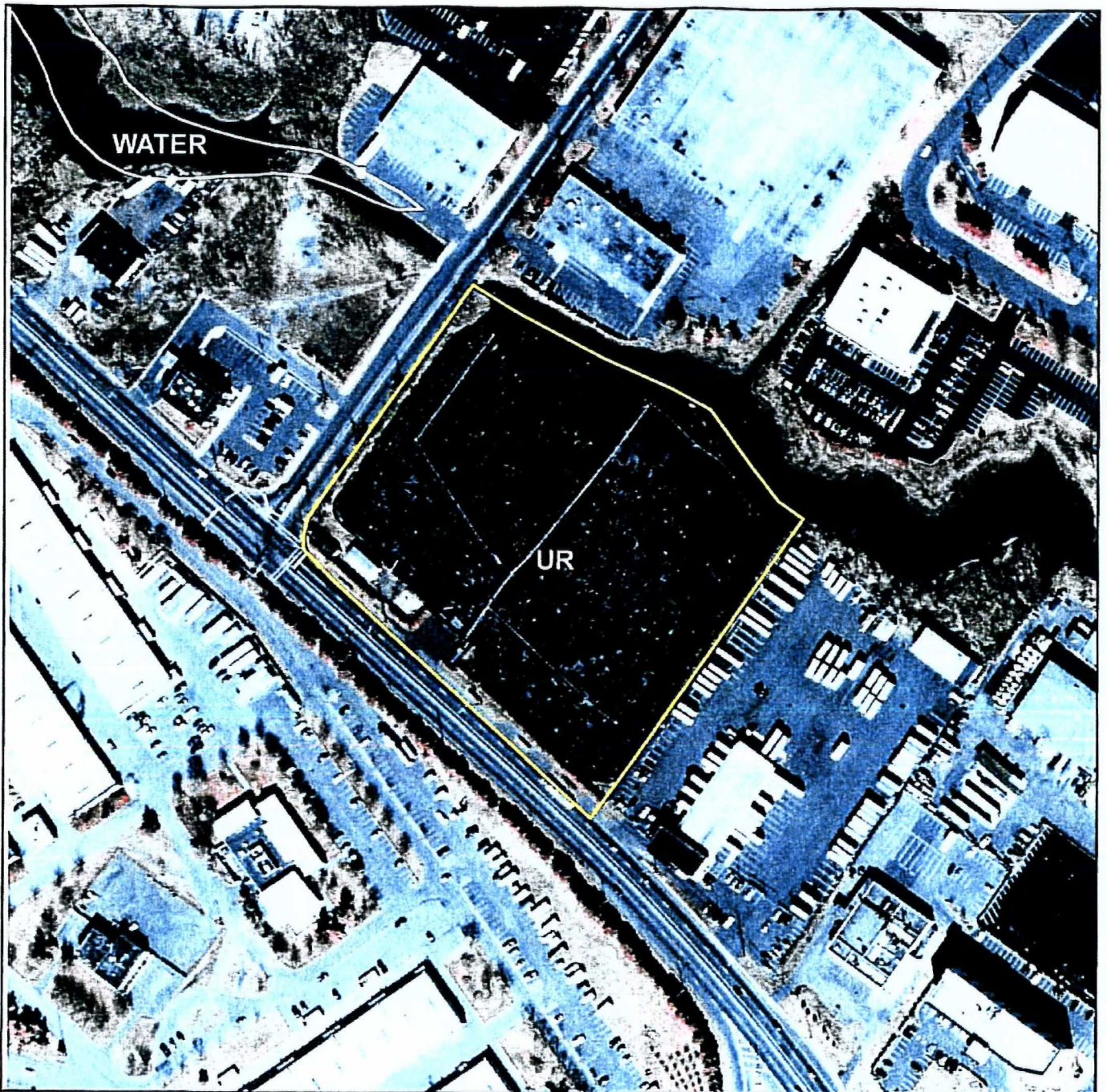
Block 124; Lots 1,2,3,4, and 5
Borough of Carlstadt
Bergen County, New Jersey

ASGECI Project #2425

2,000

Feet

AMY S. GREENE
ENVIRONMENTAL
CONSULTANTS.



Legend

 Site Location

SOILS LIST:
UR - Urban Land

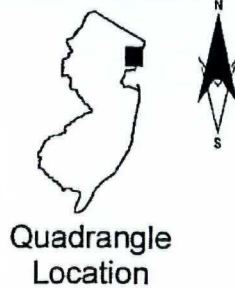


Figure 4 SSURGO Soils Map

Block 124; Lots 1,2,3,4, and 5
Borough of Carlstadt
Bergen County, New Jersey

ASGECI Project #2425

Sources:
Soil Survey Geographic (SSURGO) database for Bergen County, New Jersey, USDA, Natural Resources Conservation Service, Fort Worth, Texas, December 2004.

New Jersey 2002 High Resolution Orthophotography, State of New Jersey, NJDEP, Office of Information Technology, Trenton, July 2003.

200
Feet

AMY S. GREENE
ENVIRONMENTAL
CONSULTANTS

SECTION #4

Minor Stream Encroachment Permit Equivalency
Block 124; Lots 1, 2, 3, 4 & 5
Carlstadt Borough, Bergen County, New Jersey
ASGECI #2425

**SITE PHOTOGRAPHS WITH DESCRIPTIONS
TAKEN IN OCTOBER 2004**



Photo A – View, facing southwest, of the Paterson Plank Road Superfund site.



Photo B – View, facing southwest, of the site.



Photo C – View, facing northeast, of the of the northwestern property boundary adjacent to Gotham parkway. Hydrophytic vegetation noted in low-lying areas of plastic-lined drainage channels; however, this area is not considered a wetland.



Photo D – View, facing northwest, of the northeastern portion of the site. The sheet pile bulkhead is located on the opposite of the fence (right).



Photo E – View, facing southeast, of the northeast portion of the site. The sheet pile bulkhead and Peach Island Creek are located on the opposite side of the fence (left).

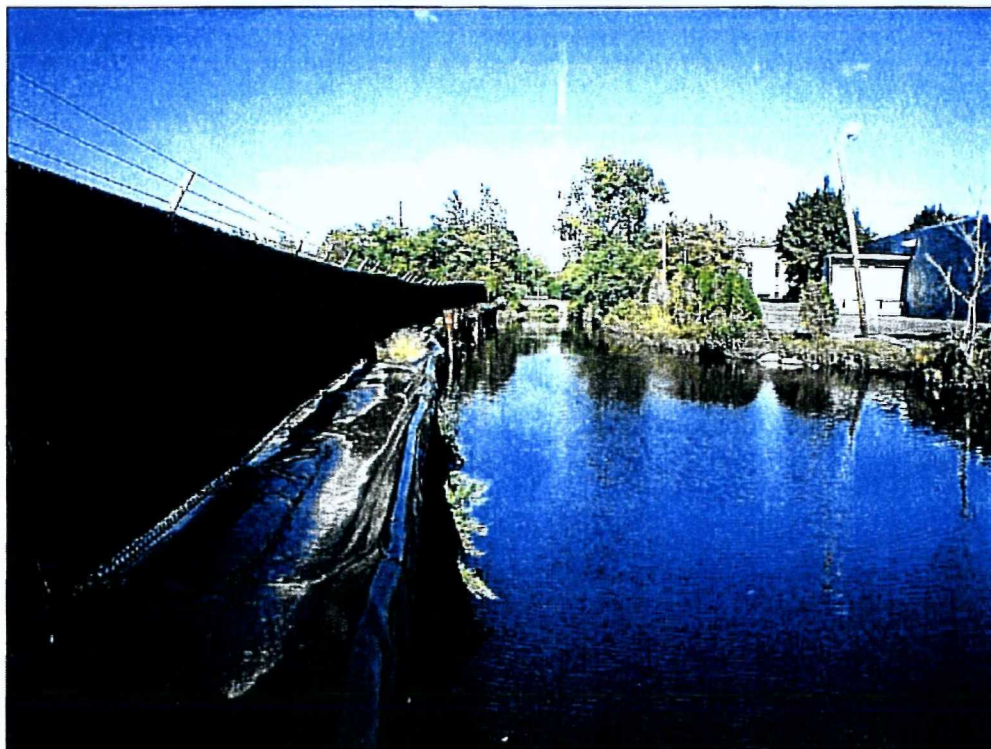


Photo F – View, facing northwest, of the existing sheet pile bulkhead adjacent to Peach Island Creek.

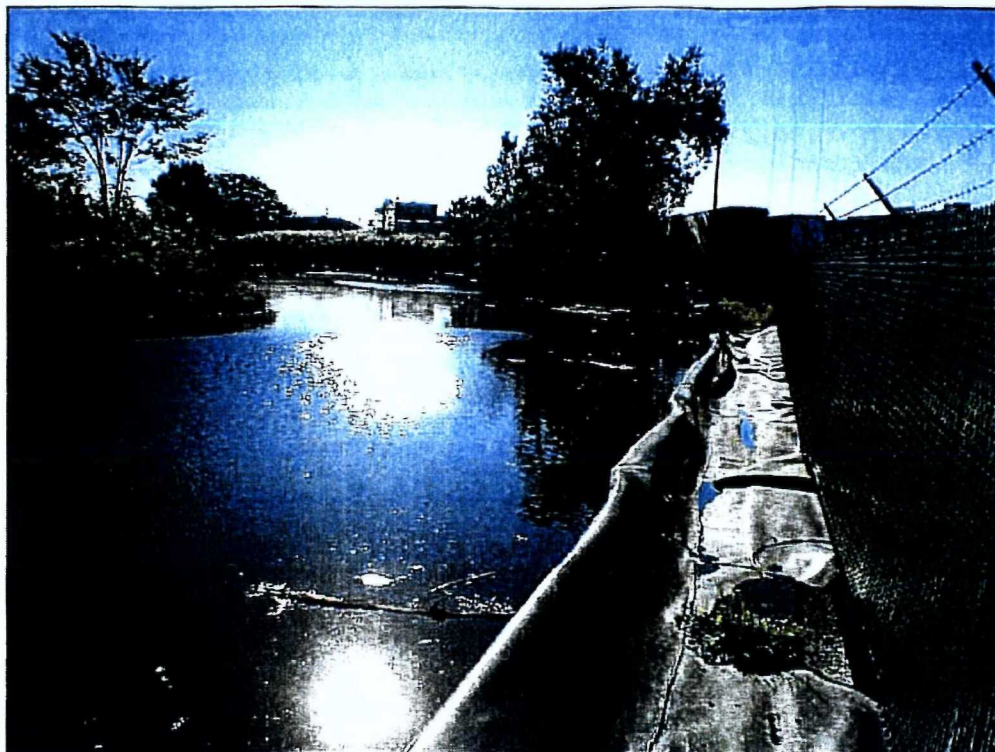


Photo G – View, facing southeast, of the existing sheet pile bulkhead adjacent to Peach Island Creek.



Photo H – View, facing northwest, of the sheet pile bulkhead and Peach Island Creek.

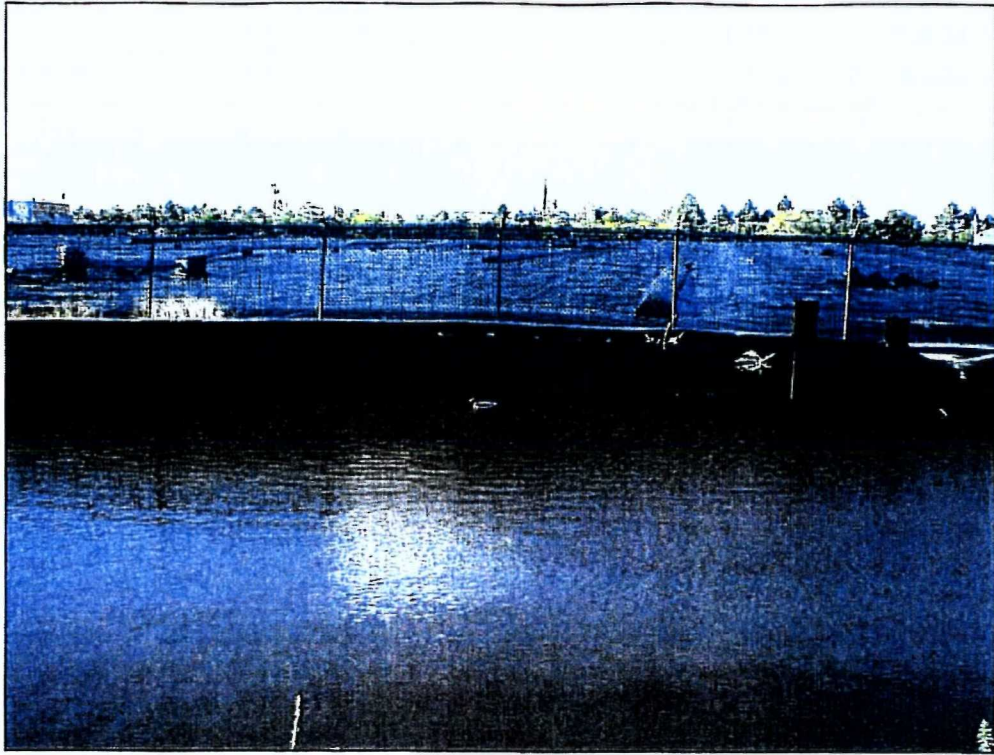


Photo I – View, facing west-southwest, of the existing bulkhead and Peach Island Creek.

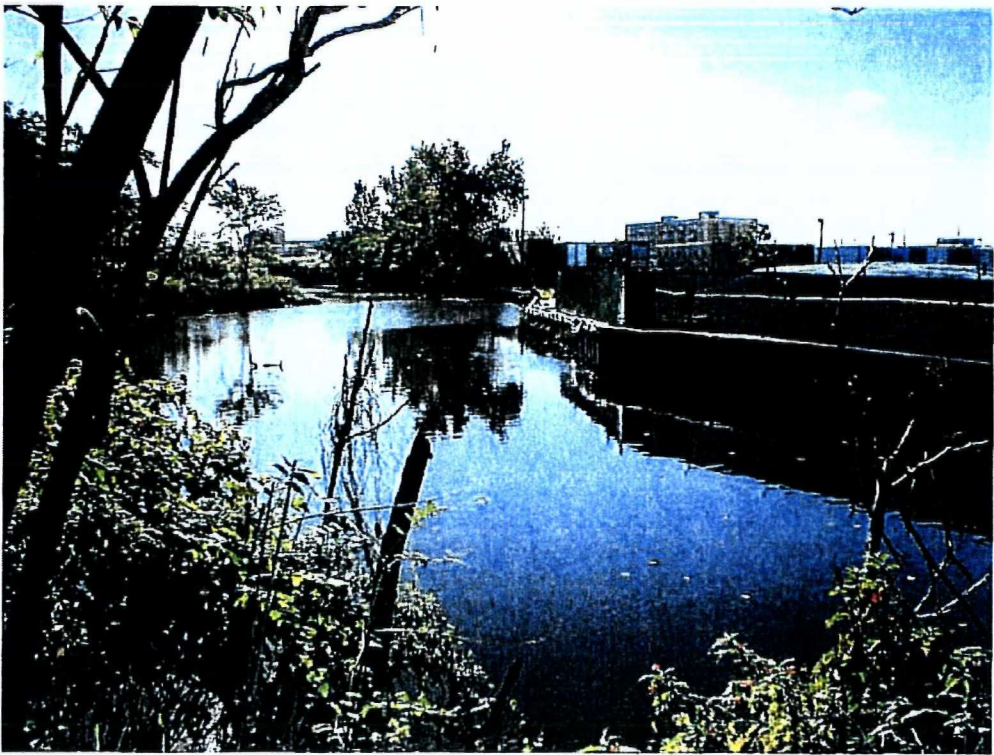


Photo J – View, facing south, of the existing bulkhead and Peach Island Creek.

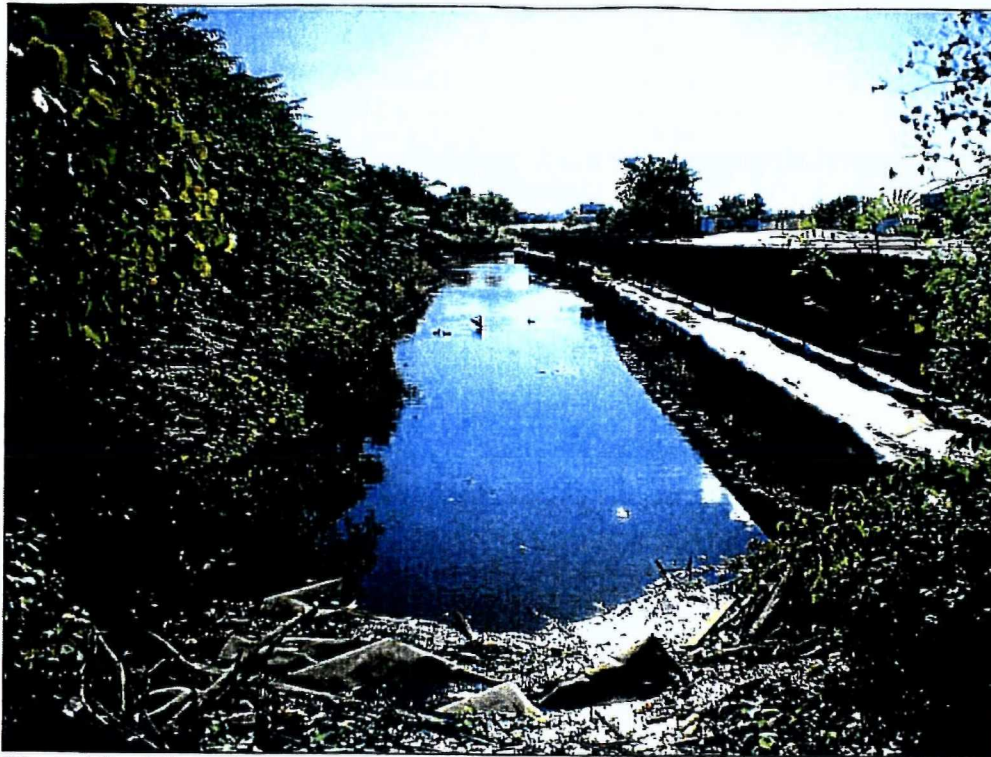


Photo K – View, facing southeast from Gotham Parkway, of Peach Island Creek and the existing bulkhead (right).

SECTION #5

Minor Stream Encroachment Permit Equivalency

Block 124; Lots 1, 2, 3, 4 & 5

Carlstadt Borough, Bergen County, New Jersey

ASGECI #2425

CORRESPONDENCE

Natural Heritage Letter, dated April 12, 2007



JON S. CORZINE
Governor

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
Division of Parks and Forestry
Office of Natural Lands Management
Natural Heritage Program
P.O. Box 404
Trenton, NJ 08625-0404
Tel. #609-984-1339
Fax. #609-984-1427

LISA P. JACKSON
Commissioner

April 12, 2007

John Pabish
Amy S. Greene Environmental Consultants, Inc.
4 Walter E. Foran Boulevard, Suite 209
Flemington, NJ 08822-4666

Re: Paterson Plank Road #216 Superfund Site - ASGECI # 2425

Dear Mr. Pabish:

Thank you for your data request regarding rare species information for the above referenced project site in Carlstadt Borough, Bergen County.

Searches of the Natural Heritage Database and the Landscape Project (Version 2) are based on a representation of the boundaries of your project site in our Geographic Information System (GIS). We make every effort to accurately transfer your project bounds from the topographic map(s) submitted with the Request for Data into our Geographic Information System. We do not typically verify that your project bounds are accurate, or check them against other sources.

Neither the Natural Heritage Database nor the Landscape Project has records for any rare wildlife species on the referenced site.

We have also checked the Natural Heritage Database and the Landscape Project habitat mapping for occurrences of any rare wildlife species or wildlife habitat within one half mile of the referenced site. Please see the table below for species list and conservation status.

Species within one half mile of referenced site.

Common Name	Scientific Name	Federal Status	State Status	Grank	Srank
colonial waterbird foraging habitat					
northern harrier	<i>Circus cyaneus</i>		E/U	G5	S1B,S3N
yellow-crowned night-heron foraging habitat	<i>Nyctanassa violacea</i>		T/T	G5	S2B

We have also checked the Natural Heritage Database for occurrences of rare plant species or ecological communities. The Natural Heritage Database does not have any records for rare plants or ecological communities on or within one half mile of the site.

The Natural Heritage Database has records for occurrences of rare plant species and ecological communities that may be present on the Weehawken USGS quadrangle. The attached list provides additional information about these occurrences. Also attached is a list of rare species and ecological communities that have been documented from Bergen County. If suitable habitat is present at the project site, these species have potential to be present.

Status and rank codes used in the tables and lists are defined in the attached EXPLANATION OF CODES USED IN NATURAL HERITAGE REPORTS.

In order to red flag the general locations of occurrences of rare and endangered plant species and ecological communities, we have prepared computer generated Natural Heritage Index Maps. Enclosed please find the map for the Weehawken USGS quadrangle. If individual projects are to be located in the areas of the map that contain letter codes, the Natural Heritage Program can be contacted for additional information.

If you have questions concerning the wildlife records or wildlife species mentioned in this response, we recommend that you visit the interactive I-Map-NJ website at the following URL, <http://www.state.nj.us/dep/gis/depsplash.htm> or contact the Division of Fish and Wildlife, Endangered and Nongame Species Program at (609) 292 9400.

PLEASE SEE THE ATTACHED 'CAUTIONS AND RESTRICTIONS ON NHP DATA'.

Thank you for consulting the Natural Heritage Program. The attached invoice details the payment due for processing this data request. Feel free to contact us again regarding any future data requests.

Sincerely,

Herbert A. Lord

Herbert A. Lord
Data Request Specialist

cc: Robert J. Cartica
NHP File No. 07-4007471

SECTION #6

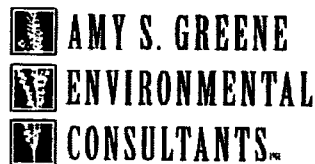
Minor Stream Encroachment Permit Equivalency

Block 124; Lots 1, 2, 3, 4 & 5

Carlstadt Borough, Bergen County, New Jersey

ASGECI #2425

RESUME OF PREPARER



AMY S. GREENE
Principal Ecologist
ASCE Grade PIX

YEARS OF EXPERIENCE: 32

EDUCATION: M.S. Ecology, 1984, Rutgers University; B.A. Biology, 1974, Boston University

PROFESSIONAL REGISTRATIONS AND TRAINING

USACE Certified Wetland Delineator, 1994; Society of Wetland Scientists Certified Professional Wetland Scientist, 1995; Ecological Association of America Certified Senior Ecologist, 1995; NJDEP Bureau of Discharge Prevention Certified Ecologist/Ornithologist, 1992. Pinelands Nursery Native Plant Symposium, 2002 and 2000; Wetlands Regulatory Workgroup National Hydric Soils Workshop, 2001; OSHA Certified Health & Safety Training (HAZWOPER), 1991; Wetland Training Institute's Wetland Functions and Values Training, 1990; Jurisdictional Delineation of Wetland Ecosystems in the Mid-Atlantic States, including wetland vegetation, hydric soils and wetland hydrology training, 1988; USFWS Habitat Evaluation Procedures, 1984; Cook College, Rutgers University Training Courses: Technical Training for Proposed Stormwater Management Rule & BMP Manual, November 2003; Threatened & Endangered Species, 2000; Environmental & Ecological Risk Assessment For Hazardous Waste, 1999; Protecting Watersheds In Central & Southern N.J., 1999; Identification of Grasses, Sedges, Rushes, 1995; Advanced Wetland Delineation including soils, vegetation and hydrology -South N.J., 1995. U.S. Fish and Wildlife Service (PA) Endangered Species Survey Course, 2002. Pennsylvania Association of Environmental Professionals Training In Section 4(f) Resource Evaluation, 2002. U.S. Army Corps of Engineers/Pennsylvania Department of Environmental Protection Regulatory Update Program, 2003. PA Association of Environmental Professional/USFWS and PA Fish & Boat Commission Bog Turtles and the Environmental Review Process in PA Course, October 2003. USOSHA HAZWOPER 8-Hour Refresher, 2004, 2005, 2006, 2007; NJ Landscape Project Mapping Training, 2005.

Professional Memberships: Society of Wetland Scientists; Ecological Society of America

Instructor: Cook College, Rutgers University, For Continuing Education - Environmental Impact Statement Preparation; Environmentally Sensitive Area Mapping for DPCC/DCR Plans; Wetland delineation and regulations, Professional Society of Land Surveyors, 2001-2006.

KEY QUALIFICATIONS

Ms. Greene is President and owner of Amy S. Greene Environmental Consultants, Inc. (ASGECI). As such, she has been providing professional environmental services to private and public sector clients since February 1986. She is a recognized expert in the field of wetland science, natural resources inventory, endangered and threatened species studies and environmental impact assessment. Amy Greene is principal in charge of all projects for ASGECI. She has managed and performed wetland delineations, prepared successful State and Federal permit applications and prepared mitigation plans and performed monitoring of wetland mitigation projects for coastal and inland wetlands. She has conducted vegetation and wildlife habitat evaluations, endangered and threatened species surveys, natural resources inventories, and environmental impact assessments. She has prepared environmental permit applications for Coastal and Pinelands Region approvals in New Jersey. Projects have been performed in many eastern states for residential, commercial and industrial development, open space and recreation, wastewater, water supply, utilities, sludge, solid waste, port and transportation facilities. Environmental Impact Statements have been prepared in accordance with National Environmental Policy Act and State and local regulations.

RELEVANT EXPERIENCE

Route 1 Pedestrian Bridge, Lawrence Township, Mercer County, NJ. NJDOT/Arora Associates. Principal in charge of oversight of a wetland delineation, preparation of an alternatives analysis, compilation of the Categorical Exclusion Documentation (CED) including preparation of the Ecology and Permits and Environmental Permits/Coordination sections of the CED. All work was performed in accordance with NJDOT Design Manual Procedures and FHWA NEPA regulations. Successful permit applications for a NJDEP Freshwater Wetlands Transition Area Waiver for Linear Development and Minor Stream Encroachment Permit were also prepared.

NJDOT/PB America. Route 23 Sussex Bypass & Papakating Creek Bridge Replacement. Wantage Township & Sussex Borough, Sussex County, NJ. Principal responsible for preparation of NJDEP Freshwater Wetlands Individual Permit application, and NJDEP Stream Encroachment Permit Environmental Report. Performed Wetland Mitigation Site Search and prepared conceptual wetland mitigation plan to compensate for approximately 0.75 acre of freshwater wetland disturbance. Assisted in Phase II Bog Turtle Visual Survey and coordinated with NJDEP and USFWS.

Former Paddington Estates, Mile Run Stream, City of New Brunswick, Middlesex County, NJ. Ferer Fersko, Attorneys. Principal responsible for wetland delineation and preparation of successful applications to the NJDEP for General Permit No. 4 and a Minor Stream Encroachment Permit for removal of contaminated soil from the 1-1/4 mile-long stream corridor. A Wetland and Stream Corridor Restoration Plan in accordance with N.J.A.C. 7:7A-14.4 to mitigate wetland and upland disturbances was also approved. ASGECI provided environmental construction monitoring of the site for the required 5 years.

Arora and Associates/New Jersey Department of Transportation. Northern Bridge Scour Countermeasure Project, Various Townships throughout Sussex, Passaic, Bergen, and Morris Counties. Principal in charge of conducting wetland delineations and obtaining permits for twenty-nine (29) bridges that will be undergoing repairs to counter scour damage. Permits required included NJDEP - Waterfront Development, Stream Encroachment, and Freshwater Wetlands; US Army Corps of Engineers - Nationwide 404/10 Wetlands Permit. Coordination with NJDEP and USFWS representatives was conducted to expedite the permit review process.

Woodward and Millhurst Roads Improvements, Manalapan Township, Monmouth County, New Jersey. Principal responsible for the preparation and submission to NJDEP of an application for and Individual Freshwater Wetlands and Open Water Fill Permit and the environmental report for a Major Stream Encroachment Permit Application for proposed roadway improvements, including the relocation of a portion of an existing stream, involving the use of biostabilization techniques. The project included coordination with multiple design engineers, the township and county for preparation of site plans.

Proposed extension of Water Transmission Main, Manalapan Township, Monmouth County, New Jersey. K. Hovnanian Companies. Principal responsible for the preparation of an application for a General Permit No. 2 and a Minor Stream Encroachment Permit for the proposed construction of a water main. The project included coordination with the project engineer as well as Manalapan Township.



SECTION #7

Minor Stream Encroachment Permit Equivalency

Block 124; Lots 1, 2, 3, 4 & 5

Carlstadt Borough, Bergen County, New Jersey

ASGECI #2425

STABILITY ANALYSIS FOR PROPOSED BULKHEAD

See Appendix F of the 100% Design Report entitled:
Stream bank Enhancement Suitability Analysis, dated 10/26/2006.

SECTION #8

Minor Stream Encroachment Permit Equivalency
Block 124; Lots 1, 2, 3, 4 & 5
Carlstadt Borough, Bergen County, New Jersey
ASGECI #2425

PERMIT PLANS

Entitled:

216 Paterson Plank Road Site
Final (100%) Design Report for OU-2
Carlstadt, Bergen County, New Jersey

See the 100% Design Report for the following:

Figures:

- 3. Site Plan
- 4. Grading and Drainage Plan
- 5. Grading and Drainage Details
- 6. Soil Erosion and Sediment Control Plan
- 7. Soil Erosion and Sediment Control Details
- 13. Sheet Pile Wall and Section
- 14. Sheet Pile Wall Details
- 19. Remedial Design/Remedial Action Schedule

Dated:

May 2007, no revisions

Prepared By:

Mark F. McNeilly
Golder Associates, Inc.
744 Broad Street, 25th Floor
Newark, New Jersey